Pest Management Research Report - 1999

an annual compilation of information garnered by researchers
in the area of crop and animal protection
materials, strategies and methods.

101-02015/

Agriculture and Agri-Food Canada Agriculture et Agroalimentaire Canada

Canada

1999 Pest Management Research Report (PMRR)

1999 Growing Season

1999 Rapport de recherches sur la lutte dirigée

pour le saison 1999

Compiled for
The Expert Committee on Integrated Pest Management,
by
Southern Crop Protection and Food Research Centre (SCPFRC),
Agriculture and Agri-Food Canada (AAFC),
London, Ontario, Canada N5V 4T3.

February, 2000.

Compilé par
le Comité d'experts sur la lutte intégrée,
par
Centre de recherches du Sud sur la phytoprotection et les aliments
Agriculture et Agroalimentaire Canada,
London (Ontario) Canada N5V 4T3.

Février, 2000.

Contact: S.A. Hilton hiltons@em.agr.ca

This annual report is designed to encourage and facilitate the rapid dissemination of pest management research results, particularly of field trials, amongst researchers, the pest management industry, university and government agencies, and others concerned with the development, registration and use of effective pest management strategies. The use of alternative and integrated pest management products is seen by the ECIPM as an integral part in the formulation of sound pest management strategies. If in doubt about the registration status of a particular product, consult the Pest Management Regulatory Agency, Health Canada at 1-800-267-6315.

This year there were 129 reports. The Expert Committee on Integrated Pest Management is indebted to the researchers from provincial and federal departments, universities, and industry who submitted reports, for without their involvement there would be no report. Special thanks is also extended to the section editors for reviewing the scientific content and merit of each report, and to Stephanie Hilton for editorial and computer compilation services.

Suggestions for improving this publication are always welcome.

La compilation du rapport annuel vise à faciliter la diffusion des résultats de la recherche dans le domaine de la lutte anti-parasitaire, en particulicr, les études sur la terrain, parmi les chercheurs, l'industrie, les universités, les organismes gouvernementaux et tous ceux qui s'intéressent à la mise au point, à l'homologation et à l'emploi de stratégies antiparasitaires efficaces. L'utilisation de produits de lutte intégrée ou de solutions de rechange est perçue par Le Comité d'experts sur la lutte intégrée (CELI) comme faisant parti intégrante d'une stratégie judicieuse en lutte antiparasitaire. En cas de doute au sujet du statut d'enregistrement d'un produit donné, veuillez consulter Health Canada, Agence de Réglementation de la lutte anti-parasitaire à 1-800-267-6315.

Cette année, nous avons donc reçu 129 rapports. Les membres du Comité d'experts sur la lutte intégrée tiennent à remercier chaleureusement les chercheurs des ministères provinciaux et fédéraux, des universités et du secteur privé sans oublier les rédacteurs, qui ont fait la révision scientifique de chacun des rapports et en ont assuré la qualité, et Stephanie Hilton qui ont fourni les services d'édition et de compilation sur ordinateur.

Vos suggestions en vue de l'amélioration de cette publication sont toujours très appréciées.

The **PMRR** is indexed by crop, pest, pest management methods, product, author and establishment.

65 reports				
SECTION A - I			ENTOMOLOGY	ENTOMOLOGIE
	Page # [1]	Report # [2]		
A	1-77	1-37	Fruit - Insect Pests of Tree Fruits - Insect Pests of Berry Crops	Insectes des arbres fruitiers Insectes des petits fruits
B	78-135	38-52	Vegetables and Special crops	Légumes et cultures spéciales
C	136-156	53-57	Potatoes	Pommes de terre
D	-		Medical and Veterinary	Médical et vétérinaire
E	157-162	58-59	Cereals, Forage crops and Oilseeds	Céréales, cultures fourragères et oléagineux
F	-		Ornamentals and Greenhouse	Plantes ornementales et de serre
G	163-166	60-61	Basic studies (Entomology)	Études de base (entomologie)
H (a-c)	167-170	62-63	Pest Management Methods	Méthodes de lutte dirigée
Ha	-		Biological Control - Weeds	Lutte biologiques - mauvaises herbes
Hb	Appendix	1-Hb	Biological Control - Insects, Mites, Nematodes	Lutte biologiques - insectes, acariens, nématodes
Hc	167-170	62-63	Semiochemicals - Insect Pheromones and Natural Products	Sémiochimiques - Phéromones des insectes et prodruits naturelles
I	171-174	64-65	Insect and Mite Pest Surveys and Outbreaks *	Enquêtes phytosanitires et infestations

[1] numéro de page [2] enregistrement

* **Note:** This is a new section for 1999

64 reports				
SECTIONS J - Q			PLANT PATHOLOGY	PHYTOPATHOLOGIE
	Page #	Report #		
J	175-207	66-78	Fruit - diseases	Fruit
K	208-238	79-89	Vegetables and special crops	Légumes et cultures spéciales
L	239-304	90-112	Field legumes	Légumineuses de grande culture
M	305-313	113-116	Potatoes	Pommes de terre
N	314-350	117-127	Cereal, forage and oilseed crops	Céréales, cultures fourragères et oléagineux
O	-	-	Ornamentals, greenhouse and turf	Plantes ornementales, de serre et de gazon
P	351-355	128	Nematodes	Nématodes
Q	356-358	129	Residues	Résidus

INDEXES	
Index 1.	Authors / Auteurs
Index 2.	Crop/Host / Hôtes (cultures)
Index 3.	Pests / Ravageurs 3a. Insects, Mites / Insects, acariens 3b. Diseases / maladies des plantes
Index 4.	Pest Management and Biological Control Methods / Méthodes de lutte dirigée et de lutte biologique
Index 5.	Products / Produits (chimiques) 5a. Entomology 5b. Plant Pathology
Index 6.	Establishments / Établissements
Index 7.	Editors / réviseurs

Year 2000 PMRR

Information for submission of reports will be sent out in September, 2000. Deadline for submission to Section Editors is December, 2000. Contact S.A. Hilton.

Index 1. AUTHORS / AUTEURS	Page #	Report #
ANDERSON, T R	330	122
ARSENAULT, W	305, 308	113, 114
BARR T R	90, 102, 112, 131, 146, 152	42, 46, 47, 51, 56, 57
BASSENDOWSKI K A	314, 318	117, 118
BEKKERING, C	310	115
BÉLANGER B	136	53
BRIANT M A	239, 266, 268, 280, 291	90, 95, 96, 101, 106
BROOKES V R	178, 195, 198, 211	67, 74, 75, 80
BROWN, J	237	89
BUCHWALD T L	272, 275, 277, 288	98, 99, 100, 105
BURKE D A	241, 251, 256, 261	91, 92, 93, 94
BURKNESS, E C	171	64
BYERS S D	356	129
CERKAUSKAS, R F	237	89
CHANG K F	239, 266, 268, 270, 280, 282, 284, 286, 291, 293, 295, 297, 299, 301, 303	90, 95, 96, 97, 101, 102, 103, 104, 106, 107, 108, 109, 110, 111, 112
CHEVERIE R	141	55
CHONGO G	272, 275, 277, 288	98, 99, 100, 105
CHOUINARD G	173	65
COSSENTINE J	163	60
ERRAMPALLI D	305, 308	113, 114
FISHER-FLEMING, B	169	63
FONSECA E J A	102	46
GAGNON S	Appendix	
GAUL S O	167	62
GERRITS T L	2, 6	1,3
GILBERT, J	341	124
GOSSEN B D	272, 275, 277, 288, 314, 318	98, 99, 100, 105, 117, 118
GROHS R	126	49
HAAG P	163	60
HALLETT, R H	82, 87	40, 41
HARDMAN J M	2, 4, 6, 8	1, 2, 3, 4
HARRIS B J	78, 80, 92, 94	38, 39, 43, 44
HEDGES, W	169	63
HENNING K V	126	49
HILL B D	356	129
HILTON S A	165	61
HOEPTING C A	128, 223, 226, 229	50, 83, 84, 85
HOGG T J	261	94
HOOKER D C	327, 330, 334	121, 122, 123
HOVIUS M H Y	231, 233	86, 87
HOWARD R J	239, 241, 251, 256, 261, 266, 268, 270, 280, 282, 284, 286, 291, 293, 295, 297, 299, 301, 303	90, 91, 92, 93, 94, 95, 96, 97, 101, 102, 103, 104, 106, 107, 108, 109, 110, 111, 112
HUGGONS S P	241, 251, 256, 261	91, 92, 93, 94

HUTCHISON, W D	171	64
HWANG S F	266, 268, 270, 280, 282, 284, 286, 288, 291, 293, 295, 297, 299, 301, 303	95, 96, 97, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112
INABA D J	356	129
JAIME M D L A	231, 233	86, 87
JANSE S	134, 235, 351	52, 88, 128
JENSEN L	163	60
JOHNSTON A	325	120
KIRKHAM C	325	120
KUSHALAPPA, A C	218	81
KUTCHER H R	288, 322, 325	105, 119, 120
LAFOND G	272	98
LASHUK, L C	163, 176, 184, 186, 189, 191, 193, 202, 204, 206	60, 66, 69, 70, 71, 72, 73, 76, 77, 78
LASHUK C L	42, 76	19, 37
MACARTHUR D C	165	61
MACDONALD, I	138, 141	54, 55
MACINTYRE J K	96	45
MACISAAC KA	305, 308	113, 114
MACKENZIE K A	167	62
MAHAR, A	34, 36, 38, 40	15, 16, 17, 18
MARTIN K	325	120
McANINCH A L	90, 112, 131, 146, 152	42, 47, 51, 56, 57
McDONALD M R	128, 134, 208, 220, 223, 226, 229, 231, 233, 235, 351	50, 52, 79, 82, 83, 84, 85, 86, 87, 88, 128
McFADDEN G A	90, 131	42, 51
MCFADDEN-SMITH, W	182	68
McKEOWN A	90	42
MORIN Y	173	65
MOY P	102	46
MURCHIE K J	116, 126	48, 49
MUSQUA D R	58, 60, 62, 64, 66, 68, 70, 72, 74	28, 29, 30, 31, 32, 33, 34, 35, 36
NEILL G B	58, 60, 62, 64, 66, 68, 70, 72, 74	28, 29, 30, 31, 32, 33, 34, 35, 36
O'FLAHERTY, C	34, 36, 38, 40	15, 16, 17, 18
ORR DD	322	119
PAGE NT	282, 284, 291, 299, 301	102, 103, 106, 110, 112
PAGÉ D	136	53
PEDERSON M R	261	94
PHILIP HG	42, 76, 169	19, 37, 63
POGODA, M K	11, 14, 17, 20, 23, 25, 27, 29, 31, 33, 44, 45, 47, 48, 50, 52, 54, 56	5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 20, 21, 22, 23, 24, 25, 26, 27
PREE, D J	11, 14, 17, 20, 23, 25, 27, 29, 31, 33, 44, 45, 47, 48, 50, 52, 54, 56	5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 20, 21, 22, 23, 24, 25, 26, 27
REMPEL S J	78, 80, 92, 94	38, 39, 43, 44
REYNARD D A	58, 60, 62, 64, 66, 68, 70, 72, 74	28, 29, 30, 31, 32, 33, 34, 35, 36
RIGBY S	34, 36, 38, 40	15, 16, 17, 18
ROBERTS L A	208, 220	79, 82
ROGERS M L	2, 6	1, 3

SCHAAFSMA A W	157, 161, 327, 330, 334, 344, 346, 349	58, 59, 121, 122, 123, 125, 126, 127
SCHNICK P J	78, 80, 92, 94	38, 39, 43, 44
SCOTT-DUPREE C D	78, 80, 92, 94, 96, 128, 223	38, 39, 43, 44, 45, 50, 83
SHEFFIELD, C	34, 36, 38, 40	15, 16, 17, 18
SHEPHARD T	163	60
SHOLBERG P L	163, 176, 184, 186, 189, 191, 193, 202, 204, 206	60, 66, 69, 70, 71, 72, 73, 76, 77, 78
SHOLBERG P	163	60
SMITH M	138, 141	54, 55
SMITH R F	34, 36, 38, 40	15, 16, 17, 18
SOROKA, J J	171	64
SPONAGLE G	8	4
STEWART J	138, 141	54, 55
TAMBURIC-ILINCIC L	344, 346, 349	125, 126, 127
TOLMAN J H	90, 96, 102, 112, 116, 126, 131, 146, 152, 165	42, 45, 46, 47, 48, 49, 51, 56, 57, 61
TROMBLEY, M	34, 36, 38, 40	15, 16, 17, 18
TURKINGTON TK	322	119
TURNBULL G D	266, 268, 270, 280, 282, 284, 286, 291, 293, 295, 297, 299, 301, 303	95, 96, 97, 101, 102, 103, 104, 106, 107, 108, 109, 110, 111, 112
VAN DEN BERG, C G J	310, 312	115, 116
VAN ROESSEL W	239	90
VANDER KOOI K	134, 235, 351	52, 88, 128
VENETTE, R C	171	64
WANG H	280, 286, 297, 299, 303	101, 104, 109, 110, 112
WEARING, L P	182	68
WONG B	314, 318	117, 118
WRIGHT, D S	182	68
CORMIER, D.	173	65

Index 2. CROP / HOST	Page #
Alfalfa	171, 314, 318
Apples	2, 4, 6, 8, 11, 14, 17, 20, 23, 25, 27, 29, 31, 33, 34, 36, 38, 40, 169, 176
Barley	322, 325
Beans, dry	239, 241, 251, 256, 261
Beans, kidney	157
Beans, white	157
Beans, soy	157, 330, 334
Blueberry, highbush	178
Blueberry, lowbush	167
Broccoli	78, 80
Cabbage	82, 87, 90, 208
Canola	325
Carrot	351
Cauliflower	92, 94, 208
Cherries, sweet	76, 202, 204, 206
Chickpea	266, 268, 270, 272, 275
Chinese Kale	220
Choke cherry	58, 60, 62, 64, 66, 68, 70, 72, 74
Corn	161, 327
Cucumber	211
Eggplant	102, 112
Field pea	288, 291, 293, 295, 297, 299, 301, 303, 325
Fruit bins	163
Grapes	42, 44, 182, 184, 186, 189
Lentils	277, 280, 282, 284, 286
Lettuce	218
Ginseng, North American	126
Onions, yellow cooking	128, 134, 223, 226, 229, 231, 233, 235
Peach	45, 47, 191, 193
Pear	48, 50, 52, 54, 56
Pomme de terre	136, 173
Potato	136, 138, 141, 146, 152, 165, 173, 305, 308, 310, 312
Pumpkin	96
Rape, flowering edible	220
Raspberry	195
Rutabaga	82
Shanghai pak choy	220
Squash	96
Strawberry	198
Sugar beet	237
Summer Turnip	131
Tobacco, flue-cured	116
Wheat	325, 341, 344, 346
White green heart	220

Index 3a. PESTS - Insects, Mites, Nematodes	**Page #**
Alfalfa blotch leafminer (*Agromyza frontinella* (Rondani)	171
Aphids (Homoptera: Aphididae)	141
Apple sucker, *Cacopsylla mali* (Schmidb)	4
Apple brown bug, *Atractotomus mali* (Meyer)	2, 4, 8
Blueberry maggot adult, *Rhagoletis mendax* Curran(L.)	167
Cabbage looper *Trichoplusia ni* (Hubner)	78, 80, 92, 94
Cabbage maggot, *Delia radicum* (Linnaeus)	82, 87, 90, 131
Choke cherry midge, *Contarinia virginianae* Felt.	58, 72
Codling moth, *Cydia pomonella* (Linnaeus)	14, 20, 34, 36, 40, 163, 169
Colorado potato beetle, *Leptinotarsa decemlineata* (Say)	102, 112, 136, 138, 141, 146, 152, 165
Diamondback moth, *Plutella xylostella* (L.)	78, 80, 92, 94
Doryphore de la pomme de terre, *Leptinotarsa decemlineata* (Say)	136
European Red Mite, *Panonychus ulmi* (Koch)	11, 17, 173
Eye-spotted bud moth, *Spilonota ocella ra* (D. & S.)	8
Fall Webworm, *Hyphantria cunea* (Drury)	68
Fruittree leafoller, *Archips argyrospila* (Walker).	64, 70
Grape Leafhopper, *Erythroneura comes* (Say)	44
Green apple aphid, *Aphis pomi* DeGeer	6
Imported cabbage worm, *Artogeia rapae* (L.)	78, 80, 92, 94
Leafroller, *Archips purpurana* (Clemens)	126
Leafrollers	4
Lesion Nematode (*Pratylenchus penetrans*)	351
Mullein bug, *Campylomma verbasci* (Meyer)	4, 8, 11, 17, 173
Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)	23, 25, 27, 29, 31
Onion maggot, (*Delia antiqua* Meigen)	128, 134
Oriental Fruit Moth, *Grapholita molesta* (Busck)	45, 47
Pale apple leaf roller, *Pseudexentera mali*	8
Pear Rust Mite, *Epitrimerus pyri* (Nalepa)	56
Pear Psylla, *Psylla pyricola* (Foerster)	48, 50, 52, 54
Pin Nematode (*Paratylenchus* spp)	351
Plum Curculio, *Conotrachelus nenuphar* (Herbst)	14, 20, 33, 48, 50, 52
Potato flea beetle, *Epitrix cucumeris* (Harr.)	141
Prairie tent caterpillar, *Malacosoma californicum lutescens* (Neumoegen & Dyar)	62
Punaise de la molène, *Campylomma verbasci* Meyer	173
Root Knot Nematode, *(Meloidogyne hapla)*	351
Rosy apple aphid *Dysaphis plantaginea* (Passerini)	4, 6, 8
Seed corn maggot, *Delia platura*	157
Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (F.)	11, 14, 17, 20
Striped cucumber beetle, *Acalymma vittatum* (Fabricius)	96
Tétranyque à deux points *Tetranychus urticae* Koch	173
Tétranyque rouge, *Panonichus ulmi* (Koch)	173
Tobacco aphid, *Myzus nicotianae*	116
Two-Spotted Spider Mite, *Tetranychus urticae* Koch	11, 17, 173
Ugly nest caterpillar, *Archips cerasivorana* (Fitch).	60, 74
Various insects	66
Virginia Creeper Leafhopper, *Erythroneura ziczac* Walsh	42
Western Grape Leafhopper, *Erythroneura elegantula* Osborn	42

Western Cherry Fruit Fly, *Rhagoletis indifferens* Curran	76
Winter moth, *Opherophtera brumata* (L.)	8, 36
Wireworm, Elateridae, sp unknown	161

3b. PESTS - Diseases	**Page #**
Anthracnose (*Colletotrichum truncatum* (Schwein.) Andrus & Moore)	277
Ascochyta blight (*Ascochyta lentis* Vassilievsky)	277
Ascochyta blight, *Ascochyta rabiei* (Pass.) Lab.	272, 275
Ascochyta blight, *Ascochyta fabae* f.sp. *lentis* Gossen	280
Black scurf (*Rhizoctonia solani* Kühn)	305, 308
Blackleg, *Leptosphaeria maculans* (Desm.) Ces and de Not	325
Blossom blight (*Botrytis cinerea* and *Sclerotinia sclerotiorum*)	314, 322
Brown rot, *Monilinia fructicola* (Wint.) Honey	191, 193, 202, 204, 206
Bunch rot, *Botrytis cinerea* Pers.:Fr.	184, 186, 189
Cercospora blight (*Cercospora beticola*) Sacc.	195, 198, 237
Cladosporium sp.	195, 198
Clubroot, *Plasmodiophora brassicae*	208, 220
Common blight, *Xanthomonas campestris* pv. *phaseoli* (ATTC 9563)	241, 251, 256, 261
Corn seedling diseases	327
Downy Mildew, *Bremia lactucae* Regel.	218
Dry rot (*Fusarium* spp.)	305
Fruit rots, *Botrytis cinerea, Colletotrichum gloeosporioides* and *Alternaria* sp.	178
Fusarium seedling blight, *Fusarium graminearum* Schwabe	349
Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (Burkh.)	239, 241, 251, 256, 261
Late blight, *Phytophthora infestans* (Mont.) de Bary	310, 312
Loose smut, *Ustilago tritici*	344
Mummy Berry, *Monilinia vaccinii-corymbosi*	178
Mycosphaerella blight *(Mycosphaerella pinodes* Berk. & Blox.)	288, 291, 293, 325
Mycosphaerella blight, *Phoma medicaginis* Malbr. & Roum. *var. pinodella* (Jones) Boerema	325
Net blotch, *Pyrenophora teres* Drechs.	322, 325
Onion Smut *(Urocystis cepulae* Frost)	223, 226, 229, 235
Phytophthora rot *(Phytophthora sojae* {Kauf. & Gerd.})	330
Powdery mildew, *Podosphaera leucotrica* (Ell. and Ev.) Salm.	176
Powdery mildew, *Uncinula necator* (Schwein)Burrill	182, 184, 186, 189
Powdery mildew, *Erysiphe pisi* Syd.	295
Powdery mildew, *Erysiphe graminis* f. sp. *tritici*	346
Pythium Root Die Back (*Pythium* spp.)	351
Pythium aphanidermatum (Edson) Fitzp.	211
Rhizopus sp.	195, 198
Root rot, *Fusarium avenaceum* (Fr.) Sacc.	266, 286, 303
Root rot, *Pythium ultimum* Trow, *P. irregulare* Buisman	268, 284, 299, 301
Root rot, *Rhizoctonia solani* Kühn	270, 282, 297
Scald (*Rhynchosporium secalis*)	322
Sclerotinia stem rot, *Sclerotinia sclerotiorum* (Lib.) De Bary	325
Septoria complex, *Septoria tritici Rob. In* Desm. *and S. nodorum* (Berk.) Berk.	325
Silver scurf *(Helminthosporium solani* Dur. and Mont.)	305, 308
Soybean diseases	334

Tan spot *(Pyrenophora tritici-repentis (*Died.) Drechs., *anamorph Drechslera tritici-repentis (*Died.) Shoem.) 325, 341
Tan spot, *Pyrenophora tritici-repentis* (Died.) Drechs. 325, 341
White rot, *Sclerotium cepivorum* (Berk) 231, 233

Index 4. PEST MANAGEMENT AND BIOLOGICAL CONTROL METHODS

		Page #
Allium products		229
Bacillus thuringiensis var. *kurstaki*		23, 25, 36, 60, 62, 68, 74, 126
Bait and Kill		38
BASF CM (unknown pheromone composition)		34
Beneficial nematodes, *Steinernema feltiae*		14
Cultivars/breeding lines tested for susceptibility to disease		231
Effect on parasitoids:	*Pholetesor ornigis*, *Sympiesis spp.* (*Hymenoptera:Chalcidoidea*)	11, 17
Effect on predators:	*Amblyseius fallacis* (Garman)	11, 14, 17, 20
	Balaustium putmani Smiley	14, 20
	Zetzelia mali (Ewing)	14, 20
Germination stimulants		226
Lure, standard red septa/codling moth sex pheromone		169
Lure, Flexlure/codling moth sex pheromone		169
Mating disruption		34
Micronutrients		256
MINERALL Clay		176
Oviposition deterrents		82
pH effect		141
Punaise de la molène, *Campylomma verbasci* Meyer (Hereroptera: Miridae)		173
Rotation		325
Slope effect		318
Software (BREMCAST) for disease severity values of downy mildew in lettuce		218
Soil additives		208, 220
Tillage		325
Timing		322
Traps, wing		169
Traps, IPM Technologies		167
Traps, Pherocon AM ammonium baited (conventional)		167

Index 5. PRODUCTS

5a Insecticides (and other compounds from Entomology Section)	Page #
abamectin (AGRI-MEK)	11
acephate (ORTHENE)	31, 45, 72, 116
acetamiprid (EXP61486A)	40, 42, 146
ACTARA (thiamethoxam)	4, 17, 48, 50, 90, 112, 131, 136, 138, 146, 152
ADAGE (thiamethoxam)	157, 161
ADMIRE (imidacloprid)	2, 6, 42, 44, 76, 96, 102, 112, 116, 131, 136, 138, 141, 146, 152
AGRI-50 (2% sodium lauryl sulfate)	42
AGRI-MEK (abamectin)	11
agricultural adjuvant	36
AGRO 2000 (proprietary)	146, 152
AGROX DL PLUS (lindane + captan + diazinon)	157, 161
AMBUSH (permethrin)	126
amitraz (MITAK)	52, 54
APRON (metalaxyl)	157, 161
AVAUNT (indoxacarb, DPX MPO26)	8
azinphosmethyl (GUTHION, SNIPER)	8, 14, 20, 27, 29, 31, 33, 44, 45, 48, 90, 96, 165
AZTEC (phosetbupirin + cyfluthrin)	128, 223
Bacillus thuringiensis var. *kurstaki*	23, 25, 36, 60, 62, 68, 74, 126
BASF CM (unknown pheromone composition)	34
CANON (fipronil)	90
captan	6, 157, 161
carbaryl (SEVIN XLR PLUS)	42, 58, 60, 62, 64, 66, 70
carbathiin	128, 157
chlorfenapyr	165
chlorpyrifos (LORSBAN)	87, 90, 128, 131, 134
COMPANION (spreader/sticker)	36, 40
CONFIRM (tebufenozide)	6, 11, 20, 23, 25, 34, 36, 40
cyfluthrin	128
CYGON (dimethoate)	76
cyhalothrin-lambda (MATADOR)	47, 58, 60, 62, 64, 70
cypermethrin (RIPCORD)	6, 36, 96, 165
cyromazine (GOVERNOR)	128
DECIS (deltamethrin)	78, 80, 92, 94
DECIS (deltamethrin)	11, 17, 27, 29, 31, 45, 50, 58, 60 62,64,70, 72, 74,
diazinon	157, 161
dicofol (KELTHANE)	56
dimethoate (CYGON)	76
DIPEL	23, 25, 36, 60, 62, 68, 74, 126
DITHANE (mancozeb)	128
DPX MP062 30 WG (indoxacarb)	146
endosulfan (THIODAN)	96, 102, 165
EXP61486A (acetamiprid)	40, 42, 146
fipronil (CANON, REGENT)	90, 128, 165, 223
fludioxinil (MAXIM)	157, 161
Formic acid and glacial acetic acid	163

GO1A3A	157
GO1A3B	157
GO1B2 (LS176 + metalaxyl)	161
GO1B3 (LS176 + metalaxyl + imidacloprid)	161
GO1B4 (LS176 + metalaxyl + imidacloprid)	161
GO1B5 (LS176 + metalaxyl + imidacloprid)	161
GOVERNOR (cyromazine)	128, 223
GUTHION (azinphosmethyl)	8, 14, 20, 27, 29, 31, 33, 44, 45, 48
imidacloprid (ADMIRE)	2, 6, 42, 44, 76, 96, 102, 112, 116, 131, 136, 138, 141, 146, 152, 161, 165
IMIDAN (phosmet)	36, 40, 45
INCITE (piperonyl butoxide)	146
indoxacarb (AVAUNT, DPX-MP062)	8, 27, 29
iprodione	90
ISOMATE-C (dodecadien-1-ol, Dodecanol, tetradetanol, inert ingredients	34
KELTHANE (dicofol)	56
LAST CALL (dodecadien-1-ol, Dodecanol, tetradetanol, inert ingredients, permethrin)	38
LORSBAN (chlorpyrifos)	87, 90, 128, 131, 134, 223
Lure, standard red septa/codling moth sex pheromone	169
Lure, Flexlure/codling moth sex pheromone	169
MAESTRO (captan)	6
MALATHION	2
mancozeb	128
MATADOR (cyhalothrin-lambda)	47, 58, 60, 62, 64, 70
MAXIM (fludioxinil)	157, 161
metalaxyl (APRON)	90, 157, 161
methamidophos (MONITOR)	141
methoxfenozide (RH 2485)	11, 20, 23, 25, 36, 47
MITAC (amitraz)	52, 54
MONITOR (methamidophos)	141
N001/99 WP (diazinon + captan)	161
N002/99 WP (diazinon + captan)	157
N003/99 WP (diazinon + captan)	161
ORTHENE (acephate)	31, 45, 72, 116
permethrin (AMBUSH, POUNCE)	38, 126, 157
PFIZOL-10 (N-decanol, sucker control agent)	116
phosalone (ZOLONE FLO)	34, 38
phosetbupirin	128
phosmet (IMIDAN)	90
piperonyl butoxide (INCITE)	146
pirimicarb (PIRIMOR)	4, 6
PIRIMOR (pirimicarb)	4, 6
POUNCE (permethrin)	126
PRO GRO (carbathiin + thiram)	128
PYRAMITE (pyridaben)	52, 54, 56
pyridaben (PYRAMITE)	52, 54, 56

REGENT (fipronil) 128, 223
RH 2485 methoxfenozide 11, 20, 23, 25, 36, 47
RIPCORD (cypermethrin) 6, 36, 96
Saccharopolyspora spinosa (SPINOSAD, SUCCESS) 72, 76, 78, 80, 92, 94
Seed treatments 128, 157, 161
SEVIN XLR PLUS (carbaryl) 42, 58, 60, 62, 64, 66, 70
Sinapic acid 82
SNIPER (azinphosmethyl) 90, 96
sodium lauryl sulfate 42
spinosad, *Saccharopolyspora spinosa* (SUCCESS) 78, 80, 92, 94
SPINOSAD (spinosyns, *Saccharopolyspora spinosa*) 72, 76
Strip, flexure 82
SUCCESS (spinosad, *Saccharopolyspora spinosa*) 78, 80, 92, 94
tebufenozide (CONFIRM) 6, 11, 20, 23, 25, 34, 36, 40
thiamethoxam (ACTARA, ADAGE) 4, 17, 48, 50, 90, 112, 131, 136, 138, 146, 152, 157, 161
THIODAN (endosulfan) 96, 102
thiram/carbendazim 90
thiram 128, 157
TI-435 157
Traps, wing 169
Traps, IPM Technologies 167
Traps, Pherocon AM ammonium baited 167
VITAFLO (thiram + carbathiin) 157
ZOLONE FLO (phosalone) 34, 38

5b. Fungicides and compounds from Plant Pathology Section	Page #
2,4-D	356
ABOUND (azoxystrobin)	182, 193, 204, 280, 291
ACTIGARD (CGA-245704)	293, 295
ADAGE (thiamethoxam)	266, 268, 284, 286, 301, 303, 327
AGRAL 90 (isobutanol, nonyl phenol ethoxylates)	208, 220
AGRICULTURAL STREPTOMYCIN	241, 251, 256, 261
ALIETTE (fosetyl-al)	178, 211
APRON (metalaxyl)	270, 282, 297, 349
APRON MAXX (metalaxyl-m/fludioxonil)	266, 268, 284, 286, 301, 303, 330, 334
APRON XL (metalaxyl-m)	266, 268, 286, 284, 299, 301, 303, 327, 330, 334, 344, 349
APRON XL/MAXIM (metalaxyl-m/fludioxonil/difenaconazole)	330
AZTEC (phosetbupirin + cyfluthrin)	223
BAS 500	280, 291
BENLATE (benomyl)	178, 314, 318
BLUESTONE (copper sulfate)	241, 251
BRAVO (chlorothalonil)	178, 198, 237, 272, 275, 277, 288, 310, 312, 314
BRAVO ULTREX (chlorothalonil)	275, 277, 280, 288, 291
BREMCAST	218
bromoxynil	356
CAPTAN	299
CLEAR	299
DADS (diallyl disulphide)	226, 229
dicamba	356
diclofop	356
DITHANE (mancozeb)	223, 235, 308, 310, 314
DIVIDEND (difeconazole)	266, 268, 284, 286, 301, 303, 344, 349
DIVIDEND/MAXIM (difenaconazole/fludioxonil)	305
DIVIDEND XL (difeconazole + metalaxyl)	344, 349
DPDS (n-propyl disulphide)	226, 229
EASOUT (Thiophanate-methyl)	305
ELEVATE 50 WDG (fenhexamid)	178, 189, 195, 198, 206
EXP80472J (triticonazole 2.63 %)	349
EXP80991A (ICIA5504 800 g/kg)	349
fenoxaprop	356
FLINT (trifloxystrobin, CGA-279202)	182, 293, 295
FLUAZINAM (fluazinam)	312
fludioxonil/metalaxyl-M/difenoconazole	334
FOLICUR (tebuconazole)	231, 233
GARLIC JUICE (diallyl disulphide)	229
GARLIC POWDER (diallyl disulphide)	229
GARLIC OIL (composition unknown)	229
GOVERNOR (cyromazine)	223, 235
GROW-TEC PROTEC polymer (water soluble organic polymer)	251
HELIX GREEN (thiamethoxam)	266, 268, 284, 286, 301, 303

HOMEMADE ONION JUICE (composition unknown) 229
ICIA5504 (azoxystrobin) 341
IKF-916 312
KOCIDE LF (copper hydroxide) 239
KUMULUS (sulphur) 182
Li700 (propionic acid), 310
LIME (dolomitic, calcium, magnesium). 208, 220
LO 176 270, 282, 297
LORSBAN (chlorpyrifos) 223
MAESTRO (captan) 178, 195, 198
MANEB (maneb, tebuconazole) 235, 349
MANKOCIDE (mancozeb + copper hydroxide) 310
MANZATE (mancozeb) 237
MAXIM XL (fludioxinil + mefenoxam) 327
MAXIM (fludioxinil) 266, 268, 284, 286, 301, 303, 305, 327, 330, 334
MCPA 356
mefanoxam (APRON XL) 349
methyl cellulose 235
MINERALL CLAY (glacial marine mud) 176
N002 (diazonon + captan) 334
NITRAGIN® SOIL IMPLANT PLUS (*Rhizobium phaseoli*) 241, 251, 256
NOVA (myclobutanil) 176, 182, 184, 186, 189
PERKLA (calcium oxide, cyanamide, nitrate) 208, 220
POLYRAM DF (metiram) 310
PRO GRO (carbathiin, thiram) 223, 235
QUADRIS (azoxystrobin) 237, 272, 275, 277, 288, 293, 295, 314, 325
quinclorac 356
RAXIL (tebuconazole) 231
REGENT (fipronil) 223
RH141,457B (RH117,281 + mancozeb) 310
RONILAN (vinclozolin) 325
ROVRAL (iprodione) 178, 186, 189, 191, 193, 202, 204, 206
Seed treatments 231, 235, 239, 241, 251, 256, 261, 266, 268, 270, 282, 284, 286, 297, 299, 301, 303, 327, 330, 334, 344, 346, 349
SELF-STICK™ (*Rhizobium leguminosarum* biovar *phaseoli*) 261
SENATOR (thiophanate methyl) 178
Software for disease severity values of downy mildew in lettuce 218
SOVRAN (kresoxim-methyl) 182
STRATEGO (propiconazole + CGA-279202) 293, 295
STROBY (kresoxim-methyl) 178
SWITCH (cyprodinil +fludioxonil) 178, 195, 198
TADS (triticonazole + thiram) 349
TEL C-35 (dichloropropene and chloropicrin) 351
TELONE C-17 (dichloropropene and chloropicrin) 351
TEPROSYN MN (manganese) 256
TEPROSYN CU (copper oxychloride) 256
TEPROSYN ZN (zinc) 256

TILT (propiconazole) 293, 295, 322, 325, 341
triallate 356
trifluralin 356
U2727 270, 282, 297
UBI 2051-10 (thiram + carbathiin) 346, 349
UBI 2568 (tridimenol) 346, 349
UBI 2584-1 (tebuconazole) 349
UBI 2584-3 (tebuconazole) 346, 349
VANGARD (cyprodinil) 184, 191, 193, 202
VITAFLO (thiram + carbathiin) 241, 251, 256, 261, 266, 268, 270, 282, 284, 286, 297, 301, 303, 327, 330, 344, 349
VITAVAX (carbathiin) 349
Z0007 (triadimenol uncoated fertilizer) 346
Z0008 (triadimenol coated fertilizer) 346
Z0009 (triadimenol coated fertilizer) 346
Z0010 (triadimenol millett) 346
ZINEB (zineb) 241, 251, 261

Index 6. ESTABLISHMENTS	Page #
Agriculture and Agri-Food Canada Atlantic Food And Horticulture Research Centre, Kentville, NS	2, 4, 6, 8, 34, 36, 38, 40, 167
Agriculture and Agri-Food Canada Cereal Research Centre, Winnipeg MB	341
Agriculture and Agri-Food Canada Crops and Livestock Research Centre, Charlottetown, PE	138, 141, 305, 308
Agriculture and Agri-Food Canada Greenhouse and Processing Crops Research Centre, Harrow, ON	237, 330
Agriculture and Agri-Food Canada Indian Head Research Station, SK	272
Agriculture and Agri-Food Canada Lacombe Research Centre, Lacombe, AB	322
Agriculture and Agri-Food Canada Lethbridge Research Centre, Lethbridge, AB	356
Agriculture and Agri-Food Canada Melfort Research Centre, Melfort, SK	288, 322, 325
Agriculture and Agri-Food Canada Pacific Agri-Food Research Centre, Agassiz, BC	178, 195, 198, 211
Agriculture and Agri-Food Canada Pacific Agri-Food Research Centre, Summerland, BC	163
Agriculture and Agri-Food Canada P.F.R.A., Shelterbelt Centre, Indian Head, SK	58, 60, 62, 64, 66, 68, 70, 72, 74
Agriculture and Agri-Food Canada Saskatoon Research Centre, Saskatoon, SK	171, 272, 275, 277, 288, 314, 318
Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre, Delhi, ON	126
Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre, London, ON	90, 96, 102, 112, 116, 126, 131, 146, 152, 165
Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre, Vineland, ON	11, 14, 17, 20, 23, 25, 27, 29, 31, 33, 44, 45, 47, 48, 50, 52, 54, 56
Agrilus Inc., Saint-Alexandre, Québec	173
Alberta Agriculture, Food and Rural Development Crop Diversification Centre South, SS 4, Brooks, AB	239, 241, 251, 256, 261, 266, 268, 270, 280, 282, 284, 286, 291, 293, 295, 297, 299, 301, 303

Alberta Research Council, Bag 4000, Vegreville, AB	266, 268, 270, 280, 282, 284, 286, 288, 291, 293, 295, 297, 299, 301, 303
BC Fruit Packers Cooperative, Kelowna, BC	169
BC Ministry of Agriculture and Food, Kelowna, BC	42, 76. 169
Dow Agrosciences Canada Inc., Calgary, AB	78, 80, 92, 94
ICMS, Inc., Abbotsford, BC	310, 312
Institut de recherche et de développement en agroenvironnement, Sainte-Foy, Québec	136
Institut de recherche et de développement en agroenvironnement, Saint-Hyacinthe, Québec	173
McGill University, Plant Science Department Ste. Anne de Bellevue, Quebec	218
Saskatchewan Irrigation Diversification Centre, Outlook, SK	261
Specialty Seeds Inc., Bow Island, AB	239
United States Department of Agriculture - Animal and Plant Health Inspection Service, St. Paul, Minnesota, USA	171
University of Guelph Department of Environmental Biology, Guelph, ON	34, 36, 38, 40, 78, 80, 82, 87, 92, 94, 96, 128, 223, 226, 229
University of Guelph Horticulture Research Institute of Ontario, Simcoe, ON	90
University of Guelph, Department of Plant Agriculture Horticultural Research Institute of Ontario Vineland Station, ON	182
University of Guelph, Dept. of Plant Agriculture Muck Crops Research Station, HRIO,, Kettleby, ON	128, 134, 208, 220, 223, 226, 229, 231, 233, 235, 351
University of Guelph, Ridgetown College of Agricultural Technology, Ridgetown, ON	157, 161, 327, 330, 344, 346

Index 7. 1999 EDITORS / RÉVISEURS

ENTOMOLOGY - Sections A - G

A	**FRUIT/FRUITS** **Insects of Tree Fruits**	**J. Mike Hardman** Agriculture and Agri-Food Canada Atlantic Food & Horticulture Research Centre 32 Main Street, Kentville, Nova Scotia B4N 1J5	Email: hardmanm@em.agr.ca Tel: (902) 679-5730 Fax: (902) 679-2311
A also)	**Insects of Berry Crops**	**Dr. Bruce Neill** Agriculture and Agri-Food Canada PFRA Shelterbelt Centre Indian Head, Saskatchewan S0G 2K0	Email: pf21801@em.agr.ca Tel: (306) 695-2284 Fax: (306) 695-2568
B	**VEGETABLES** **and SPECIAL CROPS**	**Dr. Jeff H. Tolman** Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre, 1391 Sandford St., London, Ontario N5V 4T3	Email: tolmanj@em.agr.ca Tel: (519) 457-1470 Ext. 232 Fax: (519) 457-3997
C	**POTATO INSECTS**	**Dr. Jeff G. Stewart** Agriculture and Agri-Food Canada Charlottetown Research Centre 440 University Avenue, P.O. Box 1210 Charlottetetown, PEI C1A 7M8	Email: stewartj@em.agr.ca Tel: (902) 566-6844 Fax: (902) 566-6821
D	**MEDICAL and** **VETERINARY**	**Dr. Doug Colwell** Agriculture and Agri-Food Canada Lethbridge Research Centre, P.O. Box 3000, Main Lethbridge, Alberta T1J 4B1	Email: colwelld@em.agr.ca Tel: (403) 327-4591 ext. 344 Fax: (403) 382-3156
E	**CEREALS, FORAGE** **CROPS** **and OILSEEDS**	**Dr. Owen Olfert** Agriculture and Agri-Food Canada Saskatoon Research Centre, 107 Science Place Saskatoon, Saskatchewan S7N 0X2	Email: olferto@em.agr.ca Tel: (306) 956-7288 Fax: (306) 956-7247
F	**ORNAMENTALS** **and GREENHOUSE**	**Dr. Les Shipp** Agriculture and Agri-Food Canada Greenhouse and Processing Crops Research Centre, Highway 18, Harrow, Ontario N0R 1G0	Email: shipps@em.agr.ca Tel: (519) 738-2251 Fax: (519) 738-2929
G	**BASIC STUDIES**	**Mrs. Stephanie A. Hilton** Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre, 1391 Sandford St., London, Ontario N5V 4T3	Email: hiltons@em.agr.ca Tel: (519) 457-1470 ext. 218 Fax: (519) 457-3997

PEST MANAGEMENT METHODS - Section H (a-c)

H a	**BIOLOGICAL** **CONTROL OF WEEDS**	**Dr. Rosemarie DeClerck-Floate** Agriculture and Agri-Food Canada Lethbridge Research Centre Highway 3 East, P.O. Box 3000, Main Lethbridge, Alberta T1J 4B1	Email: floater@em.agr.ca Tel: (403) 327-4561 Fax: (403) 382-3156

H **b**	**BIOLOGICAL CONTROL of Insects, Mites, Nematodes**	**Dr. David R. Gillespie** Agriculture and Agri-Food Canada Pacific Agriculture Research Centre (Agassiz), P.O. Box 1000, 6947 Number 7 Highway Agassiz, British Columbia V0M 1A0	Email: gillespied@em.agr.ca Tel: (604) 796-2221 ext. 210 Fax: (604) 796-0359
H **c**	**SEMIOCHEMICALS - Insect Pheromones and Natural Products**	**Dr. R.M. Trimble** Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre, 4902 Victoria Ave. N., P.O. Box 6000 Vineland Station, Ontario L0R 2E0	Email: trimbler@em.agr.ca Tel: (905) 562-4113 Fax: (905) 562-4335
I	**INSECT AND MITE PEST SURVEYS AND OUTBREAKS**	**Mr. Hugh G. Philip** British Columbia Ministry of Agriculture and Food 200-1690 Powick Road Kelowna, BC V1X 7G5	Email: hugh.philip@gems8.gov.bc.ca Tel: (250) 861-7230 Fax: (250) 861-7490

PLANT PATHOLOGY - Sections J - QP

J	**FRUIT - Diseases**	**Dr. Peter Sholberg** Agriculture and Agri-Food Canada Pacific Agri-Food Research Centre, 4200 Hwy 97 Summerland, British Columbia V0H1Z0	Email: sholbergp@em.agr.ca Tel: (250) 494-6383 Fax: (250) 494-0755
K	**VEGETABLES and SPECIAL CROPS - Diseases**	**Dr. Ray F. Cerkauskas** Agriculture and Agri-Food Canada Greenhouse and Processing Crops Research Centre, Highway 18, Harrow, Ontario N0R 1G0	Email: cerkauskasr@em.agr.ca Tel: (519) 738-2251 Fax: (519) 738-2929
L	**FIELD LEGUMES - Diseases** (Beans, peas)	**Dr. Terry Anderson** Agriculture and Agri-Food Canada Greenhouse and Processing Crops Research Centre, Highway 18, Harrow, Ontario N0R 1G0	Email: andersont@em.agr.ca Tel: (519) 738-2251 Fax: (519) 738-2929
M	**POTATOES - Diseases**	**Ms. Agnes M. Murphy** Agriculture and Agri-Food Canada Fredericton Rearch Centre 850 Lincoln Road, P.O. Box 20280 Fredericton, New Brunswick E3B 4Z7	Email: murphya@em.agr.ca Tel: (506) 452-3260 Fax (506) 452-3316
N	**CEREALS, FORAGE CROPS and OILSEEDS - Diseases**	**Dr. Richard A. Martin** Agriculture and Agri-Food Canada Charlottetown Research Centre 440 University Avenue, P.O. Box 1210 Charlottetown, P.E.I. C1A 7M8	Email: martinra@em.agr.ca Tel: (902) 566-6851 Fax: (902) 566-6821
N	**also SMUT - Diseases**	**Dr. Jim G. Menzies** Agriculture and Agri-Food Canada Winnipeg Research Centre, 195 Dafoe Road Winnipeg, Manitoba R3T 2M9	Email: jmenzies@em.agr.ca Tel: (204) 983-5714 Fax: (204) 983-4604

O	**ORNAMENTALS, GREENHOUSE and TURF - Diseases**	**Dr. Gary Platford** Soils and Crops Branch, Manitoba Agriculture Box 1149, 65 - 3rd Avenue N.E. Carman, Manitoba R0G 0J0	Email: gplatford@gov.mb.ca Tel: (204) 745-2040 Fax: (204) 745-2299
P	**NEMATODES**	**Dr. Joe Kimpinski** Agriculture and Agri-Food Canada Charlottetown Research Centre 440 University Avenue, P.O. Box 1210 Charlottetown, PEI C1A 7M8	Email: kimpinskij@em.agr.ca Tel: (902) 566-6851 Fax: (902) 566-6821
Q	**CHEMICAL RESIDUES**	**Dr. Brian D. Ripley** Lab Services Div., University of Guelph 95 Stone Road West, Loading Zone 2 Guelph, ON N1H 8J7	Email: lsd.lsd_po(BRipley) Tel: (519) 767-6206 Fax: (519) 767-6240
	CHAIRMAN of ECIPM	**Michel Letendre** Provincial IPM specialist and Minor use coordinator Ministere d l'Agriculture, des Pecheries et de l'Alimentation Direction des services technologiques 200, chemin Sainte-Foy, 9e etage Quebec G1R 4X6	Email: michel.letendre@agr.gouv.qc.ca Tel: (418) 380-2100 Fax: (418) 380-2181
	EDITOR of PMRR	**Stephanie Hilton** Agriculture and Agri-Food Canada Southern Crop Protection and Food Research Centre 1391 Sandford St. London, ON N5V 4T3	Email: hiltons@em.agr.ca Tel: (519) 457-1470 Ext. 218 Fax: (519) 457-3997

1999 PEST MANAGEMENT RESEARCH REPORT

SECTIONS: A - I

REPORT #s: 1 - 65

PAGES: 1 - 174

SECTION A - I	Page #s	Report #s	ENTOMOLOGY/	ENTOMOLOGIE
A	1-77	1-37	Fruit - Insect Pests of Tree Fruits - Insect Pests of Berry Crops	Insectes des arbres fruitiers Insectes des petits fruits
B	78-135	38-52	Vegetables and Special crops	Légumes et cultures spéciales
C	136-156	53-57	Potatoes	Pommes de terre
D	-		Medical and Veterinary	Médical et vétérinaire
E	157-162	58-59	Cereals, Forage crops and Oilseeds	Céréales, cultures fourragères et oléagineux
F	-	-	Ornamentals and Greenhouse	Plantes ornementales et de serre
G	163-166	60-61	Basic studies (Entomology)	Études de base (entomologie)
H (a-c)	167-170	62-63	Pest Management Methods	Méthodes de lutte dirigée
Ha	-	-	Biological Control - Weeds	Lutte biologiques - mauvaises herbes
Hb	-	-	Biological Control - Insects, Mites, Nematodes	Lutte biologiques - insectes, acariens, nématodes
Hc	167-170	62-63	Semiochemicals - Insect Pheromones and Natural Products	Sémiochimiques - Phéromones des insectes et prodruits naturelles
I	171-174	64-65	Insect and Mite Pest Surveys and Outbreaks	Enquêtes phytosanitires et infestations

SECTION A: TREE FRUIT AND BERRY CROPS/ARBRES FRUITIERES ET PETITS FRUITS

REPORTS /RAPPORTS # 1 - 37

PAGES: 1 - 77

EDITORS

A. Tree Fruits **J. Mike Hardman**
Agriculture and Agri-Food Canada
Atlantic Food & Horticulture Research Centre
32 Main Street, Kentville, Nova Scotia B4N 1J5
Email: hardmanm@em.agr.ca
Tel: (902) 679-5730
Fax: (902) 679-2311

A Berry Crops **Dr. Bruce Neill**
Agriculture and Agri-Food Canada
PFRA Shelterbelt Centre
Indian Head, Saskatchewan S0G 2K0
Email: pf21801@em.agr.ca
Tel: (306) 695-2284
Fax: (306) 695-2568

1999 PMR REPORT # 1 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1261-9705

CROP: Apple, cv. McIntosh
PESTS: Apple brown bug

NAME AND AGENCY:
HARDMAN J M, ROGERS M L and GERRITS T L
Agriculture and Agri-Food Canada, Atlantic Food And Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729 Fax: (902) 679-2311 Email: hardmanm@em.agr.ca

TITLE: EFFICACY OF ADMIRE AGAINST APPLE BROWN BUG IN 1998

MATERIALS: MALATHION 25WP, ADMIRE 240F (imidacloprid)

METHODS: Trees were sprayed to runoff by a truck-mounted lance gun sprayer with an orifice size of 2.5 mm at a pressure of 2800 kPa. Tree spacings were 7 x 5.5 m at a density of 260/ ha. Sets of twelve single-tree plots of 20 year old McIntosh trees per treatment were sprayed 2 June 1998. Pesticides were diluted to a rate comparable to 3000 litres/ha and each tree was sprayed with ca.10 L of solution. A pre-count was taken 29 May consisting of 5 tapped limbs per tree on 5 trees per treatment. Posttreatment counts were taken 10 and 19 June based on 5 tapped limbs per tree, approximately 20 taps per tree. Counts of apple brown bug from five trees per sample date were given the square root transformation before analysis of variance for the effect of treatments on bug counts. Insect injury to fruit was assessed 25 September on all apples (on the tree and drops) from each of eight trees per treatment up to a maximum of 100 fruit per tree. We computed the arc sine of the square root of the proportion of apples damaged before doing analysis of variance to determine whether treatments affected the amount of damage caused by these pests.

RESULTS: There was no phytotoxicity. Although the counts varied greatly between trees as demonstrated in the pre-count on 29 May all treatments showed significant control on both the June 10 and 19 samplings (Table 1). The high rate of ADMIRE exerted better control than the low rate on both sample dates--however this difference was not significant. Although there were no significant differences between the standard MALATHION and ADMIRE in the tapping tray counts, in the damage counts the damage on trees sprayed with the high rate of ADMIRE was significantly lower than for trees sprayed with MALATHION or the unsprayed control trees.

CONCLUSIONS: The data indicates that both rates of ADMIRE were comparable to or better than the standard MALATHION in decreasing apple brown bug levels and preventing damage to fruit.

Table 1. Tapping tray counts of apple brown bug 29 May (pretreatment) and 2 dates after spray.

Treatment	Rate g [AI]/ha	Counts 29 May	Counts 10 June	Counts June 19
Control	0	7.60b*	5.33a	1.20a
MALATHION 25 WP	875	14.88a	0.20b	0.00b
ADMIRE 240 F	60	6.60b	2.60ab	0.40ab
ADMIRE 240 F	91.2	14.40a	1.20ab	0.00b

* Means in the same column followed by the same letter are not different according to the Waller-Duncan *k* ratio *t*-test after square root transformation of the data.

Table 2. Percentage of apples injured by apple brown bug just before harvest (25 September 1998).

Treatment	Rate g[AI]/ha	Percentage Injury
Control	0	20.52 a*
MALATHION 25 WP	875	11.81 ab
ADMIRE 240 F	60	7.06 bc
ADMIRE 240 F	91.2	4.36c

* Means followed by the same letter are not different according to the Waller-Duncan *k* ratio *t*-test after arc sine transformation of the data.

1999 PMR REPORT # 2 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1261-9705

CROP: Apple, cv. McIntosh
PESTS: Rosy apple aphid (RAA), *Dysaphis plantaginea* (Passerini)
Apple brown bug (ABB), *Atractotomus mali* (Meyer)
Mullein bug (MB), *Campylomma verbasci* (Meyer)
Apple sucker (AS), *Cacopsylla mali* (Schmidb)
Leafrollers.

NAME AND AGENCY:
HARDMAN J M
Agriculture and Agri-Food Canada, Atlantic Food and Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729 Fax: (902) 679-2311 Email: hardmanm@em.agr.ca

TITLE: ACTIVITY OF TWO FORMULATIONS OF THE NEONICOTINOID INSECTICIDE ACTARA AGAINST APHIDS, APPLE PSYLLA AND MIRIDS ON APPLE

MATERIALS: ACTARA 25 WG (thiamethoxam), ACTARA 75 WG (thiamethoxam), PIRIMOR 80 DF (pirimicarb)

METHODS: Trials were done in an 8 yr-old block orchard of McIntosh apple trees planted at a spacing of. 7 x 5.5 m and a density of 260trees/ ha. Pre-bloom applications on five single-tree plots per treatment were made 26 May 1999 after a pre-count of insect pests was conducted. Application of insecticides in the experimental orchard was by truck-mounted sprayer with a single nozzle and an orifice of 2.5 mm. Pesticides were diluted to a rate comparable to 3000 litres/ha. ACTARA 75 WG was applied both before and after bloom, while all other treatments were applied before bloom. The post-bloom treatment was applied 31 May 1999. Aphid numbers both before and after treatment were determined through visual examination of each terminal shoot per tree. Mirid numbers were based on tapping tray counts which consisted of 2 limbs per tree with 5 taps per limb. Insect injury to fruit was assessed 14 September. Injury samples consisted of all apples from a single branch, totalling a maximum of 50 apples per tree from each of five trees per treatment. Injury samples in the control were taken on 1 November, 1999. Ten trees were examined, instead of five and dropped fruit was examined, along with fresh fruit, totalling 50 apples per tree. The arc sine of the square root of the proportion of apples damaged was computed before analysis of variance to determine whether treatments affected the amount of damage caused by mirids.

RESULTS: Results are shown in Tables 1-2.

CONCLUSIONS: Before treatments there were fewer apple brown bugs in the control plots than in those subsequently sprayed with ACTARA or PIRIMOR. Apple suckers were most abundant in the plots to be sprayed with ACTARA 75 WG or with PIRIMOR. Nine days after treatment counts of mullein bug were significantly lower than the control in all plots treated with ACTARA. Although there were fewer live colonies of rosy apple aphids on treated plots than on the control, this difference was not significant at $P =$

0.05. There were fewer apples with mirid stings in the ACTARA plots than in the control but these differences were likewise not significant at $P = 0.05$.

Table 1. Least squares means for numbers of rosy apple aphid colonies (RAA) and live apple brown bug, mullein bug and apple sucker. For a given column and date, means followed by the same letter are not significantly different according to the Waller-Duncan *k* ratio *t* test ($P = 0.05$) after square root transformation of the data (P=0.05).

Treatment	Rate g[a.i.]/ha	RAA	ABB	MB	AS
		26 May	Pre-treatment		
Control		0.00a	13.00b	5.40a	1.60ab
ACTARA 25 WG	48	0.20a	55.60a	6.40a	0.80bc
ACTARA 75 WG	79 pre-bloom and post-bloom	0.20a	44.80a	11.40a	3.40a
ACTARA 25 WG	96	0.00a	47.60a	7.00a	0.00c
PIRIMOR 80 DF	425	0.00a	61.80a	10.00a	2.80a
PIRIMOR 80 DF	850	0.00a	50.00a	8.80a	2.80a
		36680	9 Days		
Control		5.60a	0.00a	2.40b	0.40a
ACTARA 25 WG	48	0.00a	0.00a	0.00d	0.00a
ACTARA 75 WG	79 pre-bloom and post-bloom	0.00a	0.00a	0.00d	0.00a
ACTARA 25 WG	96	0.00a	0.00a	1.00cd	0.20a
PIRIMOR 80 DF	425	0.20a	0.00a	6.80a	0.40a
PIRIMOR 80 DF	850	0.00a	0.00a	2.40bc	0.20a

Table 2. Least squares means for percentage of apples showing mirid damage from apple brown bug and mullein bug. Means followed by the same letter are not significantly different according to Tukey's Studentized range test ($P = 0.05$).

Treatment	Rate g[a.i.]/ha	Percentage of fruit with mirid damage 14 September
Control		5.60a
ACTARA 25 WG	48	2.00a
ACTARA 75 WG	79 pre-bloom and post-bloom	4.00a
ACTARA 25 WG	96	3.20a
PIRIMOR 80 DF	425	4.00a
PIRIMOR 80 DF	850	6.40a

1999 PMR REPORT # 3 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 306-1261-9705

CROP: Apple, cv. McIntosh
PESTS: Rosy apple aphid *Dysaphis plantaginea* (Passerini)
Green apple aphid *Aphis pomi* DeGeer

NAME AND AGENCY:
HARDMAN J M, ROGERS M L and GERRITS T L
Agriculture and Agri-food Canada, Atlantic Food and Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729 Fax: (902) 679-2311 Email: hardmanm@em.agr.ca

TITLE: LARGE PLOT TRIALS WITH ADMIRE TO CONTROL APHIDS ON APPLE

MATERIALS: ADMIRE 240 F (imidacloprid), MAESTRO 75 DF (captan), PIRIMOR 50 DF(pirimicarb), RIPCORD 400 EC (cypermethrin), CONFIRM 240 F (tebufenozide)

METHODS: The trial was conducted in a 11 yr-old block of McIntosh on MM111 rootstock planted at a spacing of 4.3 x 6.1 m. Pesticides were applied by an airblast sprayer to plots of 19 trees in each of 2 adjacent rows (38 trees sprayed per plot). Each rate of ADMIRE and the single rate of RIPCORD were applied to single plots, whereas the same rate of PIRIMOR was applied to two plots. All insecticide treatments were tank-mixed with MAESTRO at 3.0 kg AI/ha. Pesticides were diluted to a rate comparable to 600 litres/ha with ca 350 L sprayed on each plot, which varied from 0.5 to 0.6 ha. Before the trial began with the aphicide treatments applied 28 May, both of the ADMIRE plots had been treated with RIPCORD (50 g AI/ha) 13 May 1998 whereas the PIRIMOR plots were treated with CONFIRM 240 F (240 g AI/ha) on that same date. A pretreatment count of 26 May was only done for live colonies of RAA and GAA on 10 trees per plot (Table 1). These same trees were sampled 3 times after treatment for live colonies of aphids. On 17 September the number of apples injured by RAA per 52-100 (usually 100) apples per tree was counted for each of 9-10 trees per plot (Table 3). Analysis of covariance, with pretreatment aphid count as a covariate was used to determine the effects of treatment and initital aphid counts on posttreatment aphid counts (Table 2). Pretreatment counts of rosy apple aphid were used as the covariate to estimate treatment effects on aphid injury (Table 3). Hence the least squares means in Tables 2 and 3 are adjusted to take account of pretreatment aphid densities.

RESULTS: None of the treatments caused any noticeable phytotoxicity. Results are shown in Tables 1-3.

CONCLUSIONS: There were significant variations in numbers of live aphid colonies per tree 2 days before treatment. At that time, green apple aphids were most numerous in one of the plots later sprayed with PIRIMOR, whereas the rosy apple aphid was most numerous in the ADMIRE plots and one of the PIRIMOR plots (Table 1). After treatment the number of live colonies of green apple aphid rose in the RIPCORD plot but decreased in the others. Rosy apple aphid counts were quite variable and hence there were no significant differences among treatments. Aphid injury to fruit was highest in the RIPCORD plot and significantly lower in the ADMIRE and PIRIMOR plots. The higher rate of ADMIRE was more effective than the lower rate in preventing aphid injury to fruit.

Table 1. Precount of number of live colonies of rosy apple aphid (RAA) and green apple aphid (GAA) per tree on 26 May. Means followed by the same letter are not significantly different according to Tukey's Studentized Range test after square root transformation of the data (*P* = 0.05).

Treatment	Rate g [AI]/ha	No. of trees sampled	GAA	RAA
RIPCORD 400 EC	50.0	10	1.70b	1.80b
ADMIRE 240 F	91.2	10	1.10b	6.90ab
ADMIRE 240 F	55.2	10	3.80b	8.20a
PIRIMOR 50 DF	425.0	10	9.50a	6.10ab
PIRIMOR 50 DF	425.0	10	1.90b	1.30b

Table 2. Least squares means for number of live colonies per tree of green apple aphid (GAA) and rosy apple aphid (RAA) in June and July 1998. For a given column and a given date, means followed by the same letter are not significantly different according to pairwise *t* tests after square root transformation of the data (*P* = 0.05).

		9 June		18 June		2 July	
Treatment	Rate g [AI]/ha	GAA	RAA	GAA	RAA	GAA	RAA
RIPCORD 400 EC	50.0	0.45a	4.61a	5.99a	0.60a	15.66a	0.22a
ADMIRE 240 F	91.2	0.67a	4.49a	3.70a	0.73a	1.79b	0.66a
ADMIRE 240 F	55.2	1.79a	12.82a	8.90a	0.39a	3.42b	0.99a
PIRIMOR 50 DF	425.0	0.54a	7.64a	5.70a	0.54a	6.01b	0.47a

Table 3. Least squares means for percentage of apples showing injury by rosy apple aphid when sampled on the tree 17 September 1998. Means followed by the same letter are not significantly different according to pairwise *t* tests after arcsine transformation of the square root of the proportions injured (*P* = 0.05).

Treatment	Rate g [AI]/ha	No. of trees sampled	Percent injured fruit
RIPCORD 400 EC	50.0	10	18.94a
ADMIRE 240 F	91.2	9	5.54c
ADMIRE 240 F	55.2	9	12.65b
PIRIMOR 50 DF	425.0	9	4.36c

1999 PMR REPORT # 4 **SECTION A: INSECT PESTS OF FRUIT STUDY DATA BASE:**

CROP: Apple, cv. Cortland

PESTS: Winter moth (WM), *Opherophtera brumata* (L.)
Eye-spotted bud moth (ESBM), *Spilonota ocella ra* (D. & S.)
Pale apple leaf roller (PALR), *Pseudexentera mali*
Apple brown bug (ABB), *Atractotomus mali* (Meyer)
Mullein bug (MB), *Campylomma verbasci* (Meyer)
Rosy apple aphid (RAA), *Dysaphis plantaginea* (Passerini)

NAME AND AGENCY:
HARDMAN J M and SPONAGLE G
Agriculture and Agri-Food Canada, Atlantic Food and Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia B4N 1J5
Tel: (902) 679-5729 Fax: (902) 679-2311 Email: hardmanm@em.agr.ca

TITLE: APPLICATION OF THE OXYDIAZINE INSECTICIDE AVAUNT TO CONTROL LEPIDOPTERA, MIRIDS AND APHIDS ON APPLE

MATERIALS: GUTHION 50 WP (azinphosmethyl), AVAUNT (indoxacarb, DPX MPO26) 30 WG

METHODS: Trials were done on 3.1 m tall x 5.5 m diameter Cortland apple trees in a 34 yr-old experimental orchard with sets of McIntosh, Cortland and Red Delicious trees arranged in a Latin Square. Cortland trees were planted at a spacing of 7 x 5.5 m with a density of 260trees/ ha. Sets of five single-tree plots per treatment were sprayed 31 May, 1999 after a pre-count of insect pests was conducted. Application of insecticides was by a single nozzle 2.5 mm orifice on a hose attached to a truck-mounted sprayer operating at 2800 kPa pressure. Pesticides were diluted to a rate comparable to 3000 litres/ha and sprayed to runoff. Counts of Lepidopteran larvae (final instars of winter both and bud moth, earlier instars of pale apple leafroller) both before and after treatment were determined through the examination of eight random terminal clusters per tree. Mirid numbers were based on tapping tray counts which consisted of 2 scaffold limbs per tree with 5 taps per limb. Insect injury to fruit was assessed 12 September. Injury samples consisted of all apples from a single scaffold limb, totalling a maximum of 50 apples per tree from each of five trees per treatment. The arc sine of the square root of the proportion of apples damaged was computed before analysis of variance to determine whether treatments affected the amount of damage caused by winter moth, pale apple leafroller, mirids, and rosy apple aphids.

RESULTS: Results are shown in Tables 1-3.

CONCLUSIONS: Precounts of Lepidoptera larvae in clusters (Table 1) and tapping tray counts of mirids (Table 2) did not show significant variations among treatments. At least part of the decrease in numbers of winter moth and bud moth larvae between 31 May and 8 June was due to larvae dropping from the tree as they sought pupation sites. Declines in pale apple leafroller were more likely due to mortality. No live larvae were detected in plots treated with GUTHION or the two higher rates of AVAUNT. Eight days after treatment, plots sprayed with the two higher rates of AVAUNT and

GUTHION had significantly lower numbers of apple brown bug than the control. Declines in mullein bug were likely more due to adults dispersing off the tree than to mortality (Table 2). Damage caused by lepidopteran larvae was lower than control in the plots treated with GUTHION and the two higher rates of AVAUNT but these contrasts were only significant for damage by pale apple leafroller and not for winter moth where some injury was likely caused before treatment. Trees with the lower rate of AVAUNT had significantly fewer aphid damaged fruit than did the control. With mirids there were substantial, but not significant damage reductions with GUTHION and the two lower rates of AVAUNT.

Table 1. Least squares means for numbers of live and dead lepidopteran larvae in leaf clusters. For a given column and date, means followed by the same letter are not significantly different according to Tukey's Studentized range test after square root transformation of the data ($P = 0.05$).

Treatment	Rate g[a.i.]/ha	LWM	DWM	LPALR	DPALR	LESBM	DESBM
				31 May	0 days		
Control		1.50a	0.50a	0.50a	0.00a	0.75a	0.00a
AVAUNT 30 WG	37.5	0.00a	0.54a	0.75a	0.00a	0.50a	0.00a
AVAUNT 30 WG	50.0	0.25a	0.50a	0.75a	0.00a	0.00a	0.00a
AVAUNT 30 WG	75.0	0.50a	0.00a	1.00a	0.00a	0.50a	0.00a
GUTHION 50 WP	1375.0	0.75a	0.25a	1.00a	0.00a	0.75a	0.00a
				8 June	8 days		
Control		0.00a	0.00a	0.25a	0.00a	0.00a	0.00a
AVAUNT 30 WG	37.5	0.00a	0.00a	0.25a	0.25a	0.25a	0.25a
AVAUNT 30 WG	50.0	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a
AVAUNT 30 WG	75.0	0.00a	0.00a	0.00a	0.00a	0.00a	0.25a
GUTHION 50 WP	1375.0	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a

Table 2. Least squares means for numbers of apple brown bug (ABB) and mullein bug (MB) counted on tapping trays. For a given column and date, means followed by the same letter are not significantly different according to Tukey's Studentized range test after square root transformation of the data ($P = 0.05$).

Treatment	Rate g[a.i.]/ha	ABB	MB
		June 1	Pre-Treatment
Control		16.25a	0.75a
AVAUNT 30 WG	37.5	18.50a	1.75a
AVAUNT 30 WG	50.0	23.00a	2.50a
AVAUNT 30 WG	75.0	41.75a	1.75a
GUTHION 50 WP	1375.0	28.50a	0.75a
		June 8	8 days
Control		22.50a	0.00b
AVAUNT 30 WG	37.5	13.75ab	1.25a
AVAUNT 30 WG	50.0	9.75b	0.25ab
AVAUNT 30 WG	75.0	0.75c	0.50ab
GUTHION 50 WP	1375.0	0.50c	0.00b

Table 3. Least squares means for percentage of apples showing winter moth (WM), eye-spotted bud moth (ESBM), pale apple leaf roller (PALR), mirid (apple brown bug plus mullein bug)), and rosy apple aphid (RAA) damage. Means followed by the same letter are not significantly different according to the Waller-Duncan k-ratio *t* test ($P = 0.05$).

Treatment	Rate g[a.i.]/ha	WM	ESBM	PALR	Mirid	RAA
Control		9.50a	7.00a	9.00a	9.00a	8.00ab
AVAUNT 30 WG	37.5	6.50a	6.50ab	3.50ab	5.50a	0.50b
AVAUNT 30 WG	50	1.50a	1.50ab	1.50b	3.00a	7.00ab
AVAUNT 30 WG	250	5.00a	1.50ab	2.50b	8.50a	12.50a
GUTHION 50 WP	1375	4.50a	2.50b	2.50b	1.00a	4.00ab

1999 PMR REPORT # 5 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Idared
PESTS: Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (F.)
Mullein Leaf Bug, *Campylomma verbasci* (Meyer)
European Red Mite, *Panonychus ulmi* (Koch)
Two-Spotted Spider Mite, *Tetranychus urticae* Koch
PARASITOIDS: *Pholetesor ornigis, Sympiesis spp.* (*Hymenoptera: Chalcidoidea*)
PREDATOR: *Amblyseius fallacis* (Garman)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre,
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF FIRST GENERATION SPOTTED TENTIFORM LEAFMINER AND MULLEIN LEAF BUG ON APPLE WITH VARIOUS INSECTICIDES; 1999

MATERIALS: AGRI-MEK 1.9 EC (abamectin), CONFIRM 240 F (tebufenozide), DECIS 5 EC (deltamethrin), RH 2485 80 WP

METHODS: The trial was conducted in a nine-year-old orchard in the Simcoe, Ontario area; trees cv. Idared were spaced 4.8 m by 7.2 m, and were on MM106 rootstock. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Treatments were applied at petal fall (20 May), timed for egg hatch of the first generation of Spotted Tentiform Leafminer (STLM). Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 14-15 L of spray mix were used per plot; pressure was set at 2000 kPa. SUPERIOR 70 spray oil was added to the AGRI-MEK treatment at 0.25% of the total spray volume; the spreader/sticker AGRAL 90 was added to the RH 2485 treatment at a rate of 0.1% of the total spray mix. On 3 June, plots were examined for Mullein leaf bug (MB) by tapping each tree at three equally-spaced locations (six taps per plot), and counting MB nymphs on tapping trays. Numbers of MB per six taps were recorded for each plot. On 14 June, a sample of 40 leaf clusters per plot was collected from the lower central part of the tree canopy. Samples were examined using a stereomicroscope and the percentage of clusters mined by STLM was recorded. The percentage of mines containing the parasitoids *Pholetesor ornigis* and *Sympiesis* spp. (Hymenoptera: Chalcidoidea) was also recorded. Effects on populations of European Red Mite (ERM) and two-spotted spider mite (TSSM) were also examined; ten weeks (28 July) after application, 50 leaves per plot were picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope (45 leaves brushed with a Henderson McBurnie mite brushing machine, and five leaves were examined without brushing), and numbers of live ERM motiles and TSSM motiles were recorded. Total numbers of beneficial mites observed were also recorded for each plot. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1, 2, and 3. Prespray samples 20 May showed similar numbers of STLM larvae (approximately 1.0 larvae/cluster) in all plots. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the sample taken 14 June to assess the effects of treatments on STLM, the CONFIRM treatment was significantly different from the control, but not as effective as the RH 2485 or AGRI–MEK treatments; meanwhile, the DECIS standard was not significantly different from the control (Table 1). None of the treated plots showed significantly reduced parasitism of mines by either *P. ornigis* or *Sympiesis spp.* In the 3 June sample for MB, all treated plots showed significantly lower numbers of MB than the control (Table 2). Although numbers of mites were low in all plots, none of the treatments exhibited any effects on populations of ERM or TSSM (Table 3); similarly, none of the treatments significantly reduced numbers of beneficial mites (predominately *A. fallacis*).

Table 1. Effects on spotted tentiform leafminer and parasitoids.

Treatment[1]	Rate (a.i./ha)	% mined clusters 25 Days after treatment 14 June	% mines parasitised 25 DAT 14 June
RH 2485 80 WP	240 g	0.12 c[3]	0.0 a
AGRI-MEK 1.9 EC[2]	14.25 g	0.25 c	0.0 a
CONFIRM 240 F	240 g	18.75 b	5.0 a
DECIS 5 EC	12.5 g	37.50 a	7.5 a
CONTROL	-	55.00 a	13.7 a

[1] Applied 20 May (petal fall)

[2] SUPERIOR 70 oil added at 0.25% of total spray volume

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test

Table 2. Mullein leaf bug efficacy data.

Treatment[1]	Rate (a.i./ha)	# MB per 6 taps per plot (3 June)
RH 2485 80 WP	240 g	10.0 b[3]
AGRI-MEK 1.9 EC[2]	14.25 g	13.3 b
CONFIRM 240 F	240 g	9.0 b
DECIS 5 EC	12.5 g	4.0 b
CONTROL	-	34.5 a

[1] Applied 20 May (petal fall)

[2] SUPERIOR 70 oil added at 0.25% of total spray volume

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test

Table 3. Motile mites per leaf.

Treatment[1]	Rate (a.i./ha)	ERM motiles per leaf 28 July	TSSM motiles per leaf 28 July	Beneficial mites per leaf 28 July
RH 2485 80 WP	240 g	0.07 a[3]	0.10 a	0.03 a[2]
AGRI-MEK 1.9 EC[2]	14.25 g	0.03 a	0.00 a	0.02 a
CONFIRM 240 F	240 g	0.07 a	0.01 a	0.00 a
DECIS 5 EC	12.5 g	0.07 a	0.02 a	0.03 a
CONTROL	-	0.07 a	0.07 a	0.05 a

[1] Applied 20 May (petal fall)

[2] SUPERIOR 70 oil added at 0.25% of total spray volume

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 6 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Golden Delicious
PESTS: Codling Moth, *Cydia pomonella* (L.)
Plum Curculio, *Conotrachelus nenuphar* (Herbst)
Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (F.)
PREDATORS: *Amblyseius fallacis* (Garman), *Balaustium putmani* Smiley, *Zetzelia mali* (Ewing)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre,
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: ASSESSMENT OF BENEFICIAL NEMATODES AGAINST CODLING MOTH, PLUM CURCULIO, AND SPOTTED TENTIFORM LEAFMINER ON APPLE; 1999

MATERIALS: *Steinernema feltiae*, GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a 27-year-old orchard in the Jordan Station, Ontario area; trees cv. Golden Delicious were spaced 2.5 m by 4.6 m, and were on M26 rootstock. Treatments were replicated three times and assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male codling moths (CM). The beneficial nematode *S. feltiae* was applied at a rate of one million nematodes per tree, with GUTHION applied as a standard. Treatments were applied 3 June for the first generation, 100 DD (base 10C) after first male CM catch, coinciding with egg hatch; treatments were reapplied 23 June, 250 DD (base 10C) after first application. Timing for the second generation was based on peak catches of male CM in pheromone traps; treatments were applied 20 July and reapplied 11 August. The GUTHION treatments were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 10-11 L of spray mix were used per plot; pressure was set at 2000 kPa. Nematodes were applied in a dilute suspension (3000 L per ha) at dawn, while leaves were wet with dew. Plots were first sampled 18 June; 100 apples per plot were examined on the tree for plum curculio (PC) damage. A sample was taken to assess first generation codling moth (CM) damage on 22 June and again 16 July, when 100 apples per plot were examined on the tree. Second generation CM damage was sampled on 24 August; 100 apples per plot were examined on the tree. On 21 September, a total of 100 apples per plot were harvested from the canopy and the ground, and examined for CM damage. Data were expressed as percent fruit damaged by CM or PC. Plots were sampled 24 August for effects on spotted tentiform leafminer (STLM) and beneficial mites; counts were made on 50 leaves per plot, picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope, and numbers of STLM mines/leaf and beneficial mites/leaf were recorded. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1, 2, 3, and 4. No phytotoxic effects were observed.

CONCLUSIONS: In all of the samples for CM damage, only the GUTHION treatment was better than the control. Although application timing was based on CM phenology, the effects of treatments on levels of PC damage and STLM infestations were also examined. Only the GUTHION treatments were significantly lower than the control in either of the PC or STLM samples. Numbers of beneficial mites were not significantly different from the control in any of the treated plots.

Table 1. Percent fruit damaged by codling moth.

Treatment[1]	Rate (a.i./ha)	Gen. 1		Gen. 2 24 Aug.	Harvest 21 September
		Jun 22	Jul 16		
GUTHION 50 WP	1.05 kg	0.0 b[2]	0.3 b	4.0 b	2.7 b
Steinernema feltiae	10^6/tree	1.7 a	4.7 a	21.3 a	27.3 a
CONTROL	-	6.0 a	13.3 a	21.3 a	34.7 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by plum curculio.

Treatment[1]	Rate (a.i./ha)	Sep 21
GUTHION 50 WP	1.05 kg	5.3 b[2]
Steinernema feltiae	10^6/tree	13.7 a
CONTROL	-	14.3 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 3. Spotted tentiform leafminer mines per leaf.

Treatment[1]	Rate (a.i./ha)	Aug 24
GUTHION 50 WP	1.05 kg	1.13 b[2]
Steinernema feltiae	10^6/tree	3.13 a
CONTROL	-	2.73 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Beneficial mites per leaf (on August 24).

Treatment[1]	Rate (a.i./ha)	*A. fallacis*	*Balaustium putmani*	*Zetzelia mali*	Total beneficial mites
GUTHION 50 WP	1.05 kg	0.67 a[2]	0.05 a	0.03 a	0.75 a
Steinernema feltiae	10^6/tree	0.68 a	0.00 a	0.03 a	0.71 a
CONTROL	-	0.83 a	0.01 a	0.01 a	0.87 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 7 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Idared
PESTS: Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (F.)
Mullein Leaf Bug, *Campylomma verbasci* (Meyer)
European Red Mite, *Panonychus ulmi* (Koch)
Two-Spotted Spider Mite, *Tetranychus urticae* Koch
PARASITOIDS: *Pholetesor ornigis*, *Sympiesis spp.* (*Hymenoptera: Chalcidoidea*)
PREDATOR: *Amblyseius fallacis* (Garman)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre,
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF FIRST GENERATION SPOTTED TENTIFORM LEAFMINER AND MULLEIN LEAF BUG ON APPLE WITH THIAMETHOXAM - 1999

MATERIALS: ACTARA 25 WG (thiamethoxam), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a nine-year-old orchard in the Simcoe, Ontario area; trees cv. Idared were spaced 4.8 m by 7.2 m, and were on MM106 rootstock. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Three programs were followed, the first included two rates of ACTARA, applied at pink (5 May); the second program included two rates of ACTARA applied at petal fall (20 May), timed for egg hatch of the first generation of Spotted Tentiform Leafminer (STLM); the third program included one application of ACTARA at petal fall (20 May), followed by a second application 14 days later (3 June). All treatments were compared with a DECIS standard, applied at petal fall (20 May). Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 14-15 L of spray mix were used per plot; pressure was set at 2000 kPa. On 3 June, plots were examined for Mullein leaf bug (MB) by tapping each tree at three equally-spaced locations (six taps per plot), and counting MB nymphs on tapping trays. Numbers of MB per six taps were recorded for each plot. On 14 June, a sample of 40 leaf clusters per plot was collected from the lower central part of the tree canopy. Samples were examined using a stereomicroscope and the percentage of clusters mined by STLM was recorded. The percentage of mines containing the parasitoids *Pholetesor ornigis* and *Sympiesis* spp. (Hymenoptera: Chalcidoidea) was also recorded. Effects on populations of European Red Mite (ERM) and two-spotted spider mite (TSSM) were also examined; ten weeks (28 July) after application, 50 leaves per plot were picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope (45 leaves brushed with a Henderson McBurnie mite brushing machine, and five leaves were examined without brushing), and numbers of live ERM motiles and TSSM motiles were recorded. Total numbers of beneficial mites observed were also recorded for each plot. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1, 2, and 3. Prespray samples 20 May showed similar numbers of STLM larvae (approximately 1.0 larvae/cluster) in all plots. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the sample taken 14 June to assess the effects of treatments on STLM, the ACTARA treatment that was applied twice was significantly different from the control, the DECIS standard, and the 48 g ai/ha ACTARA treatment applied at pink, but not significantly different from the other ACTARA treatments (Table 1). None of the treated plots showed significantly reduced parasitism of mines by either *P. ornigis* or *Sympiesis spp.* In the 3 June sample for MB, all treated plots showed significantly lower numbers of MB than the control (Table 2); however, the 96 g ai/ha and 79 g ai/ha treatments were significantly better than the DECIS standard. Although numbers of ERM were higher in the plots treated with two applications of ACTARA (Table 3), none of the treatments exhibited any effects on populations of beneficial mites (predominately *A. fallacis*); similarly, none of the treatments significantly affected numbers of TSSM. It should be noted that numbers of ERM and TSSM were well below the economic threshold of 10 motiles per leaf.

Table 1. Effects on spotted tentiform leafminer and parasitoids.

Treatment	Rate (a.i./ha)	% mined clusters 14 June	% mines parasitised 14 June
ACTARA 25 WG[1]	79 g	13.7 d[4]	2.5 a
ACTARA 25 WG[2]	96 g	27.5 bcd	7.5 a
ACTARA 25 WG[2]	79 g	36.2 abcd	3.8 a
ACTARA 25 WG[3]	79 g	20.0 cd	5.0 a
ACTARA 25 WG[3]	48 g	51.2 abc	2.5 a
DECIS 5 EC[2]	12.5 g	63.7 ab	3.8 a
CONTROL	-	70.0 a	13.7 a

[1] Applied 20 May (petal fall), reapplied 3 June

[2] Applied 20 May (petal fall)

[3] Applied 5 May (pink)

[4] Numbers followed by the same letter are not significantly different P<0.05, Tukey test

Table 2. Mullein leaf bug efficacy data.

Treatment[1]	Rate (a.i./ha)	# MB per 6 taps per plot (3 June)
ACTARA 25 WG[1]	79 g	1.7 bcd[3]
ACTARA 25 WG[1]	96 g	0.2 d
ACTARA 25 WG[1]	79 g	0.5 cd
ACTARA 25 WG[2]	79 g	4.2 bcd
ACTARA 25 WG[2]	48 g	7.5 b
DECIS 5 EC[1]	12.5 g	6.2 bc
CONTROL	-	43.8 a

[1] Applied 20 May (petal fall)

[2] Applied 5 May (pink)

[3] Numbers followed by the same letter are not significantly different P<0.05, Tukey test

Table 3. Motile mites per leaf.

Treatment[1]	Rate (a.i./ha)	ERM motiles per leaf 28 July	TSSM motiles per leaf 28 July	Beneficial mites per leaf 28 July
ACTARA 25 WG[1]	79 g	0.39 b[4]	0.15 a	0.45 a
ACTARA 25 WG[2]	96 g	0.06 a	0.05 a	0.08 a
ACTARA 25 WG[2]	79 g	0.16 ab	0.16 a	0.24 a
ACTARA 25 WG[3]	79 g	0.11 ab	0.39 a	0.09 a
ACTARA 25 WG[3]	48 g	0.11 ab	0.25 a	0.14 a
DECIS 5 EC[2]	12.5 g	0.05 a	0.17 a	0.08 a
CONTROL	-	0.08 a	0.18 a	0.30 a

[1] Applied 20 May (petal fall), reapplied 3 June

[2] Applied 20 May (petal fall)

[3] Applied 5 May (pink)

[4] Numbers followed by the same letter are not significantly different P<0.05, Tukey test

1999 PMR REPORT # 8 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. McIntosh
PESTS: Codling Moth, *Cydia pomonella* (L.)
Plum Curculio, *Conotrachelus nenuphar* (Herbst)
Spotted Tentiform Leafminer, *Phyllonorycter blancardella* (F.)
PREDATORS: *Amblyseius fallacis* (Garman), *Balaustium putmani* Smiley, *Zetzelia mali* (Ewing)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: ASSESSMENT OF INSECTICIDES AGAINST CODLING MOTH AND PLUM CURCULIO ON APPLE - 1999

MATERIALS: CONFIRM 240F (tebufenozide), GUTHION 50 WP (azinphos-methyl), RH 2485 80 WP

METHODS: The trial was conducted in a 27-year-old orchard in the Jordan Station, Ontario area; trees cv. McIntosh were spaced 2.5 m by 4.6 m, and were on M26 rootstock. Treatments were replicated three times and assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male codling moths (CM). Treatments were applied 3 June for the first generation, 100 DD (base 10C) after first male CM catch; treatments were reapplied 23 June, 250 DD (base 10C) after first application. Timing for the second generation was based on peak catches of male CM in pheromone traps; treatments were applied 20 July, 300 DD (base 10C) after second application, and reapplied 11 August, 250 DD (base 10C) after third application. The spreader/sticker AGRAL 90 was added to the RH 2485 treatments at a rate of 0.1% of the total spray volume. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 10-11 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were first sampled 18 June; 100 apples per plot were examined on the tree for plum curculio (PC) damage. A sample was taken to assess first generation codling moth (CM) damage on 22 June and again 16 July, when 100 apples per plot were examined on the tree. Second generation CM damage was assessed on 24 August when 100 apples per plot were examined on the tree. On 21 September; a total of 100 apples per plot were harvested from the canopy and the ground, and examined for CM damage. Efficacy was expressed as percent fruit damaged by CM or PC. Plots were sampled 24 August for effects on spotted tentiform leafminer (STLM) and beneficial mites; counts were made on 50 leaves per plot, picked randomly at arms length into the canopy. Leaves were examined using a stereomicroscope, and numbers of STLM mines/leaf and beneficial mites/leaf were recorded. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1, 2, 3, and 4. Phytotoxic effects were observed in the plots treated with RH 2485; 29% of the fruit in the plots treated with RH 2485 exhibited ring-like markings where the spray mix residue had accumulated on the bottom of the apples. This effect was attributed to the addition of the AGRAL 90 spreader/sticker, since RH 2485 had shown no phytotoxic effects when used in the past, either alone or with other surfactants. Previous studies in which the spreader/sticker COMPANION had been used showed phytotoxic effects similar to those observed with AGRAL 90.

CONCLUSIONS: In the 22 June and 16 July samples for first generation CM damage, all treated plots showed significantly lower damage than the control (Table 1). All treatments significantly reduced CM damage in the second generation sample taken 24 August. The 21 September harvest sample showed similar results, all treated plots showed lower CM damage than the control. Although application timing was based on CM phenology, the effects of treatments on levels of PC damage were also examined. In the sample taken 18 June to assess the effects of the first application on PC, all of the treatments were significantly different from the control (Table 2). All plots treated with RH 2485 showed significantly fewer STLM mines per leaf than both the control and those treated with CONFIRM; the plots treated with GUTHION showed significantly fewer leaves with STLM mines than the control (Table 3). Numbers of beneficial mites were not significantly different from the control in any of the treated plots (Table 4).

Table 1. Percent fruit damaged by codling moth.

Treatment[1]	Rate (a.i./ha)	Gen. 1 22 June	Gen. 1 16 July	Gen. 2 24 Aug.	Harvest 21 September
GUTHION 50 WP	1.05 kg	0.3 b[2]	1.7 b	3.0 b	3.0 b
CONFIRM 240F	240 g	0.0 b	0.0 b	1.3 b	4.7 b
RH 2485 80 WP + AGRAL 90	240 g	0.3 b	0.7 b	3.7 b	3.0 b
CONTROL	-	7.0 a	14.3 a	17.3 a	19.0 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Percent fruit damaged by plum curculio.

Treatment[1]	Rate (a.i./ha)	Sep 21
GUTHION 50 WP	1.05 kg	5.0 b
CONFIRM 240F	240 g	9.7 b
RH 2485 80 WP + AGRAL 90	240 g	6.7 b
CONTROL	-	20.7 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 3. Spotted tentiform leafminer mines per leaf.

Treatment[1]	Rate (a.i./ha)	Aug 24
RH 2485 80 WP + AGRAL 90	240 g	0.3 c[2]
GUTHION 50 WP	1.05 kg	2.0 bc
CONFIRM 240F	240 g	3.3 ab
CONTROL	-	5.2 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 4. Beneficial mites per leaf (Aug. 24).

Treatment[1]	Rate (a.i./ha)	*A. fallacis*	*Balaustium putmani*	*Zetzelia mali*	Total beneficial mites
GUTHION 50 WP	1.05 kg	0.71 a[2]	0.01 a	0.13 a	0.85 a
CONFIRM 240 F	240 g	0.61 a	0.03 a	0.08 a	0.72 a
RH 2485 80 WP + AGRAL 90	240 g	0.59 a	0.00 a	0.05 a	0.64 a
CONTROL	-	0.77 a	0.00 a	0.03 a	0.80 a

[1] Applied 3 June, reapplied 23 June, 20 July, 11 August; sampled 24 August

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 9 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF OVERWINTERED AND SUMMER-GENERATION OBLIQUE-BANDED LEAF ROLLER ON APPLE WITH VARIOUS INSECTICIDES - 1999

MATERIALS: CONFIRM 240F (tebufenozide), DIPEL 2X (*Bacillus thuringiensis*, subsp. *kurstaki*), RH 2485 80 WP

METHODS: The trial was conducted in a 24-year-old orchard in the Grimsby, Ontario area; trees cv. Red Delicious were spaced 1.5 m by 3.0 m, and were on M26 rootstock. Treatments were replicated four times, assigned to four-tree plots, and arranged according to a randomised complete block design. Three treatment regimes were followed, with applications at petal fall (27 May) targeting overwintered larvae followed by subsequent applications versus the first summer generation larvae. In the first regime, plots were treated with DIPEL 2X applied at petal fall (27 May), followed by CONFIRM 16 June, 130 DD (base 6.1 C) after first male moth catch, and repeated 29 June (13 days after first application). In the second, plots were treated with CONFIRM applied at petal fall (27 May) followed by DIPEL 2X 16 June, 130 DD (base 6.1 C) after first male moth catch, and repeated 29 June and 8 July (13 and 22 days after first application, respectively). The third regime included RH 2485 applied at petal fall (27 May), followed by DIPEL 2X 16 June, 130 DD (base 6.1 C) after first male moth catch, and repeated 29 June and 8 July (13 and 22 days after first application, respectively). The spreader/sticker AGRAL 90 was added to the RH 2485 treatments at a rate of 0.1% of the total spray volume. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 15-18 L of spray mix were used per plot; pressure was set at 2000 kPa. For all samples of terminals and fruit, samples were taken from the centre quadrants of the four trees in each plot. On 3 June, 100 terminals were examined per plot, and the number of terminals containing live larvae was recorded. On 20 July, 100 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 100 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. On 21 September, 80 apples per plot were harvested and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In sample 1 taken 3 June to assess the effects on infestations in terminals, all treatments were significantly different from the control; the plots treated with RH 2485 showed significantly fewer infested terminals than those treated with CONFIRM; the DIPEL 2X treatment was not significantly different from the CONFIRM or RH 2485 treatments (Table 1). In sample 2 taken 20 July to assess the effects of all treatments on infestations in terminals, the DIPEL 2X/CONFIRM regime was not significantly different from the control; the CONFIRM/DIPEL 2X and RH 2485/DIPEL 2X regimes were significantly different from the control, but the RH 2485/DIPEL 2X regime was not significantly different from the DIPEL 2X/CONFIRM regime.

All treatment regimes reduced fruit damage significantly compared to the control in the 20 July fruit sample; the CONFIRM/DIPEL 2X and RH 2485/DIPEL 2X regimes showed significantly less fruit damage than the DIPEL 2X/CONFIRM regime (Table 2). At harvest, all treated plots had significantly lower numbers of damaged fruit than the control.

Table 1. Percent terminals infested per plot.

Regime	Treatment-Overwintered Larvae	Rate (a.i./ha)	Treatment-First Summer Generation	Rate (a.i./ha)	Sample 1 3 June	Sample 2 20 July
1	DIPEL 2X[1]	2.25 kg	CONFIRM 240F[2]	240 g	2.00 bc[4]	16.2 ab
2	CONFIRM 240F[1]	240 g	DIPEL 2X[3]	2.25 kg	6.50 b	1.5 c
3	RH 2485 80WP[1]	240 g	DIPEL 2X[3]	2.25 kg	1.75 c	4.0 bc
-	CONTROL	-	CONTROL	-	18.80 a	26.8 a

[1] Applied 27 May

[2] Applied 16 June, reapplied 29 June

[3] Applied 16 June, reapplied 29 June, 8 July

[4] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Percent damaged fruit per plot.

Regime	Treatment - Overwintered Larvae	Rate (a.i./ha)	Treatment - First Summer Generation	Rate (a.i./ha)	Sample 1 20 July	Harvest Sample 21 Sept.
1	DIPEL 2X[1]	2.25 kg	CONFIRM 240F[2]	240 g	5.5 b[4]	7.2 b
2	CONFIRM 240F[1]	240 g	DIPEL 2X[3]	2.25 kg	2.2 c	11.9 b
3	RH 2485 80WP[1]	240 g	DIPEL 2X[3]	2.25 kg	2.1 c	9.4 b
-	CONTROL	-	CONTROL	-	18.0 a	25.9 a

[1] Applied 27 May

[2] Applied 16 June, reapplied 29 June

[3] Applied 16 June, reapplied 29 June, 8 July

[4] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

1999 PMR REPORT # 10 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre,
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF SUMMER-GENERATION OBLIQUE-BANDED LEAF ROLLER ON APPLE WITH VARIOUS INSECTICIDES - 1999

MATERIALS: CONFIRM 240F (tebufenozide), DIPEL 2X (*Bacillus thuringiensis*, subsp. *kurstaki*), RH 2485 80 WP

METHODS: The trial was conducted in a 24-year-old orchard in the Grimsby, Ontario area; trees cv. Red Delicious were spaced 1.5 m by 3.0 m, and were on M26 rootstock. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male moths. The trial compared five programs for control of oblique-banded leaf roller (OBLR). Two protocols were followed for CONFIRM; the first program was applied 16 June , 130 DD (base 6.1C) after first male moth catch, and repeated 13 days (29 June) after first application. The second program was applied 16 June, 130 DD (base 6.1C) after first male moth catch, and repeated 13 days (29 June) and 21 days (7 July) after first application. RH 2485 was applied as two programs; both programs were applied 16 June, 130 DD (base 6.1 C) after first male moth catch, and repeated 13 days (29 June) after first application. However, in one program the spreader/sticker AGRAL 90 was added at a rate of 0.1% of the total spray mix. The DIPEL 2X treatment was applied 16 June, 130 DD (base 6.1C) after first male moth catch, and was repeated on 29 June (13 days after initial application) and 8 July (21 days after initial application). Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. On 20 July, 50 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 50 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. On 21 September, 50 apples per plot were harvested and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. Phytotoxic effects were observed in the plots treated with RH 2485 plus AGRAL 90; 43% of the fruit in the plots treated with RH 2485 plus AGRAL 90 exhibited ring-like markings where the spray mix residue had accumulated on the bottom of the apples. This effect was attributed to the addition of the AGRAL 90 spreader/sticker, since RH 2485 showed no phytotoxic effects when used without AGRAL 90. Previous studies in which the spreader/sticker

COMPANION had been added to RH 2485 treatments showed similar phytotoxic effects.

CONCLUSIONS: In the 20 July sample of terminals, only the plots treated three times with CONFIRM did not show significantly lower terminal infestation than the control (Table 1). The percent infested terminals in the DIPEL 2X and RH 2485 plots were significantly lower than in the plots where CONFIRM was applied three times; otherwise, none of the treatments were significantly different. All of the programs significantly reduced fruit damage over the course of the season. In the 20 July fruit sample, all of the treatments significantly reduced fruit damage in comparison to the control (Table 2); similarly, at harvest, all treated plots showed significantly lower fruit damage than the control.

Table 1. Percent terminals infested per plot.

Treatment	Rate (a.i./ha)	20 July
DIPEL 2X[1]	2.25 kg	1.5 c[4]
RH 2485 80 WP[2]	240 g	2.0 c
CONFIRM 240F[2]	240 g	10.0 bc
RH 2485 80 WP + AGRAL 90[2]	240 g	11.5 bc
CONFIRM 240F[3]	240 g	26.0 ab
CONTROL	-	41.5 a

[1] Applied 16 June (130 DD from first male moth catch), reapplied 29 June, 8 July
[2] Applied 16 June (130 DD from first male moth catch), reapplied 29 June
[3] Applied 16 June (130 DD from first male moth catch), reapplied 29 June, 7 July
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent damaged fruit per plot.

Treatment	Rate (a.i./ha)	% Damaged Fruit 20 July	% Damaged Fruit Harvest 21 Sept
DIPEL 2X[1]	2.25 kg	1.0 b[4]	12.0 b
RH 2485 80 WP[2]	240 g	1.0 b	8.0 b
CONFIRM 240F[2]	240 g	2.0 b	9.0 b
RH 2485 80 WP + AGRAL 90[2]	240 g	3.0 b	5.5 b
CONFIRM 240F[3]	240 g	5.5 b	7.0 b
CONTROL	-	20.5 a	31.0 a

[1] Applied 16 June (130 DD from first male moth catch), reapplied 29 June, 8 July
[2] Applied 16 June (130 DD from first male moth catch), reapplied 29 June
[3] Applied 16 June (130 DD from first male moth catch), reapplied 29 June, 7 July
[4] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test

1999 PMR REPORT # 11 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre,
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF OBLIQUE-BANDED LEAF ROLLER ON APPLE WITH VARIOUS INSECTICIDES - 1999

MATERIALS: DECIS 5 EC (deltamethrin), DPX-MP062 30 WG (indoxacarb), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a 24-year-old orchard in the Grimsby, Ontario area; trees cv. Red Delicious were spaced 1.5 m by 3.0 m, and were on M26 rootstock. Treatments were replicated four times, assigned to two-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male moths. Treatments were applied 24 June (210 DD base 6.1C after first male moth catch); and were repeated on 7 July, 14 days after initial application. Three rates of DPX-MP062 were compared with DECIS and GUTHION standards and an unsprayed control. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. On 20 July, 50 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 50 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. On 21 September, 50 apples per plot were harvested and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the sample taken 20 July to assess the effects of treatments on infestations in terminals, only the DECIS treatment was significantly different from the control (Table 1). The levels of fruit damage in the plots treated with DECIS and GUTHION were significantly lower than in the control or those treated with DPX-MP062. In the fruit sample at harvest 21 September, the GUTHION and the DECIS treatments had significantly less fruit damage than the control plots (Table 2). The DPX-MP062 treatment programs reduced fruit damage, but were not significantly lower than the control.

Table 1. Percent terminals infested per plot.

Treatment[1]	Rate (a.i./ha)	20 July	Percent Control 20 July
DECIS 5EC	10.0 g	3.0 c[2]	91.6
GUTHION 50 WP	1.05 kg	22.5 b	37.2
DPX-MP062 30 WG	37.5 g	40.0 ab	-11.7
DPX-MP062 30 WG	50.0 g	30.0 ab	16.2
DPX-MP062 30 WG	75.0 g	49.0 a	-36.9
CONTROL	-	35.8 ab	-

[1] Applied 24 June (210 DD from first male moth catch), reapplied 7 July

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent damaged fruit per plot.

Treatment	Rate (a.i./ha)	Percent Damaged Fruit 20 July	Percent Control 20 July	Percent Damaged Fruit at Harvest 21 Sept.	Percent Control 21 Sept.
DECIS 5EC[1]	10.0 g	0.5 c[2]	98.1	6.0 d	81.5
GUTHION 50 WP	1.05 kg	7.0 bc	74.1	11.0 cd	66.2
DPX-MP062 30 WG[1]	37.5 g	20.5 ab	24.1	31.0 ab	4.6
DPX-MP062 30 WG[1]	50.0 g	14.5 ab	46.3	30.0 abc	7.7
DPX-MP062 30 WG[1]	75.0 g	25.5 ab	5.6	25.0abcd	23.1
CONTROL	-	27.0 a	-	32.5 a	-

[1] Applied 24 June (210 DD after first male moth catch), reapplied 7 July

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 12 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K, APPLEBY, M, and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF OBLIQUE-BANDED LEAF ROLLER ON APPLE WITH VARIOUS INSECTICIDES - 1999

MATERIALS: DECIS 5 EC (deltamethrin), DPX-MP062 30 WG (indoxacarb), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a 15-year-old orchard in the Brighton, Ontario area; trees cv. Red Delicious were spaced 2.0 m by 3.5 m, and were on M7 rootstock. Treatments were replicated four times, assigned to one-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male moths. Treatments were applied 28 June (200 DD base 6.1C after first male moth catch); and were repeated on 12 July, 14 days after initial application. Three rates of DPX-MP062 were compared with DECIS and GUTHION standards and an unsprayed control. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. On 27 July, 50 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 50 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were transformed (log (x + 1)), and analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the sample taken 27 July to assess the effects of treatments on infestations in terminals, only the DECIS treatment was significantly different from the control (Table 1). Levels of fruit damage in the plots treated with DECIS were significantly lower than in the control (Table 2). OBLR populations in this orchard had a history of resistance to organophosphate insecticides.

Table 1. Percent terminals infested per plot.

Treatment[1]	Rate (a.i./ha)	Jul 27	Percent Control 27 July
DECIS 5EC	10.0 g	7.0 b[2]	65.9
GUTHION 50 WP	1.05 kg	13.0 ab	36.6
DPX-MP062 30 WG	37.5 g	15.0 ab	26.8
DPX-MP062 30 WG	50.0 g	10.0 ab	51.2
DPX-MP062 30 WG	75.0 g	11.0 ab	46.3
CONTROL	-	20.5 a	-

[1] Applied 28 June (210 DD from first male moth catch), reapplied 12 July

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent damaged fruit per plot.

Treatment	Rate (a.i./ha)	Percent Damaged Fruit 27 July	Percent Control 27 July
DECIS 5EC[1]	10.0 g	3.5 b[2]	76.7
GUTHION 50 WP	1.05 kg	8.0 ab	46.7
DPX-MP062 30 WG[1]	37.5 g	11.5 ab	23.3
DPX-MP062 30 WG[1]	50.0 g	8.5 ab	43.3
DPX-MP062 30 WG[1]	75.0 g	9.0 ab	40
CONTROL	-	15.0 a	-

[1] Applied 28 June (210 DD after first male moth catch), reapplied 12 July

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 13 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Red Delicious
PEST: Oblique-Banded Leaf Roller, *Choristoneura rosaceana* (Harris)

NAME AND AGENCY:
POGODA, M K, APPLEBY, M, and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.c

TITLE: ASSESSMENT OF INSECTICIDES AGAINST OBLIQUE-BANDED LEAF ROLLER ON APPLE - 1999

MATERIALS: DECIS 5 EC (deltamethrin), ORTHENE 75 SP (acephate), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a 15-year-old orchard in the Brighton, Ontario area; trees cv. Red Delicious were spaced 2.0 m by 3.5 m, and were on M7 rootstock. Treatments were replicated four times, assigned to one-tree plots, and arranged according to a randomised complete block design. Application timing was determined from pheromone trap catches of male moths. Treatments were applied 28 June (200 DD base 6.1C after first male moth catch); and were repeated on 12 July, 14 days after initial application. Two rates of ORTHENE were compared with DECIS and GUTHION standards and an unsprayed control. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. On 27 July, 50 terminals were examined per plot, and the number of terminals containing live larvae was recorded; 50 apples per plot were also examined on the tree, and the number of damaged fruit was recorded. Efficacy ratings were expressed as percent terminals infested, and percent damaged fruit. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the sample taken 27 July to assess the effects of treatments on infestations in terminals, only the ORTHENE and DECIS treatments were significantly different from the control (Table 1). The levels of fruit damage in all treated plots were significantly lower than in the control (Table 2). OBLR populations in this orchard had a history of resistance to organophosphate insecticides.

Table 1. Percent terminals infested per plot.

Treatment[1]	Rate (a.i./ha)	July 27
DECIS 5EC	10.0 g	7.0 b[2]
GUTHION 50 WP	1.05 kg	13.0 a
ORTHENE 75 SP	562.5 g	4.0 b
ORTHENE 75 SP	750.0 g	9.5 b
CONTROL	-	20.5 a

[1] Applied 28 June (210 DD from first male moth catch); reapplied 12 July

[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

Table 2. Percent damaged fruit per plot.

Treatment[1]	Rate (a.i./ha)	Percent Damaged Fruit 27 July
DECIS 5 EC	10.0 g	3.5 b[2]
GUTHION 50 WP	1.05 kg	8.0 b
ORTHENE 75 SP	562.5 g	2.0 b
ORTHENE 75 SP	750.0 g	7.0 b
CONTROL	-	15.0 a

[1] Applied 28 June (210 DD after first male moth catch); reapplied 12 July

[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

1999 PMR REPORT # 14 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Apples cv. Empire
PESTS: Plum Curculio, *Conotrachelus nenuphar* (Herbst)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE:ASSESSMENT OF INSECTICIDES AGAINST PLUM CURCULIO ON APPLE - 1999

MATERIALS: ADMIRE 240F (imidacloprid), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a 27-year-old orchard in the Jordan Station, Ontario area; trees cv. Empire were spaced 2.5 m by 4.6 m, and were on M26 rootstock. Treatments were replicated three times and assigned to two-tree plots, and arranged according to a randomised complete block design. Treatments were applied 28 May, application timing was determined from appearance of first fruit damage by plum curculio (PC). Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled 7 June and 18 June (10 and 21 days after application, respectively); 100 apples per plot were examined on the tree for PC damage, and efficacy expressed as percent fruit damage. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in the table below. No phytotoxic effects were observed in any plots

CONCLUSIONS: In the 7 June and 18 June samples for PC damage, all treated plots showed significantly lower damage than the control (Table 1).

Table 1. Percent fruit damaged by plum curculio.

Treatment[1]	Rate (a.i./ha)	7 June 10 days after application	18 June 21 days after application
GUTHION 50 WP	1.05 kg	1.0 b[2]	1.7 b
ADMIRE 240F	91.2 g	5.3 b	6.0 b
CONTROL	-	28.0 a	27.7 a

[1] Applied 28 May
[2] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

1999 PMR REPORT # 15 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE #: 306-1261-9705

CROP: Apple, cv. McIntosh
PEST: Codling moth, *Cydia pomonella* (L),

NAME AND AGENCY:
SMITH R F[1], RIGBY S[1], SHEFFIELD, C[2], O'FLAHERTY, C[1], TROMBLEY, M[1] and MAHAR, A[1]

[1]Agriculture and Agri-Food Canada, Atlantic Food & Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia, Canada, B4N 1J5
Tel: (902) 679-5730 Fax: (902) 679-2311 Email: SmithR@em.agr.ca
[2] Department of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1

TITLE: COMPARISON OF MATING DISRUPTION AND INSECTICIDES FOR PROTECTION OF FRUIT AGAINST CODLING MOTH DAMAGE IN NOVA SCOTIA APPLE ORCHARDS

MATERIALS: ISOMATE-C (E,E-8 10 dodecadien-1-ol, 51%, Dodecanol, 29.1%, tetradetanol, 6%, inert ingredients 13.1%), BASF CM (unknown pheromone composition), CONFIRM 240F (tebufenozide) , ZOLONE FLO (phosalone)

METHODS: On May 31st, in 5 commercial apple orchards in the Annapolis Valley of Nova Scotia, BASF codling moth mating disruption ampules, 125 units per hectare, were tested as an alternative to conventional insecticides in protecting fruit from codling moth infestation and contrasted in one site with ISOMATE-C, applied at 1000 dispensers per hectare. Comparison combinations (Table 1.0) were randomly assigned to orchard blocks. Participating growers used their orchard mist sprayers delivering a 4-5x concentration of pesticide to apply CONFIRM or ZOLONE to portions of their orchard blocks in this study. Wing type pheromone traps baited with 1 mg codlemone were used to monitor codling moth abundance and seasonal flight profile in all plots and in addition in mating disruption plots Phero Tech 10 mg 'super lures' were used to track moth activity. A degree day model was used to predict • 3% egg hatch (ca. 250 • DD post biofix, i.e. first pheromone trap captures) at which point ZOLONE FLO was applied (orchard # 1) while CONFIRM 240F was applied at one litre, product/ ha 200 • DD post biofix in the orchard # 3, 4 & 5 orchards. In orchard # 2 CONFIRM was applied as a 500mL split application at 200 • DD and again ten days thereafter. Percent damaged fruit was determined by visual examination of 10 fruit on twenty trees per treatment on August 16th 1999.

Fruit injury data were transformed to $n^{0.5}$ prior to general linear model analysis and separation of the means by Least Significant Difference tests (SAS 1996).

RESULTS: The following table give fruit damage results from the pesticide evaluations conducted during 1999. The 'action threshold' (>40 moths per trap) was reached all orchards but the orchard # 5 (Table 1).

CONCLUSIONS: Mating disruption devices and CONFIRM 240F worked equally well in preventing codling moth damage in commercial orchards, as did the broad spectrum organophosphate ZOLONE

FLO. In Nova Scotia, many orchardists practising IPM tolerate 1-2% crop loss from codling moth and not more than 5% from all pests. 1999 was an abnormally hot and dry year and a partial second generation of codling moth was encountered, an event that happens once in 5-10 years. By comparison, an unsprayed commercial orchard (one year insecticide free) block had 3.20 ± 1.3% damage while 10 road side 'wild apple tree' (no history of pesticide use) sites in the Annapolis Valley had 7.2 ± 2.5% fruit loss from codling moth.

Table 1. Percent fruit damage (mean ± SE) Aug 16th 1999 from larval feeding by codling moth. Bracketed values are product application rate per hectare. Within a row, mean values sharing a common letter are not significantly different (P=.05) (LSD T-test, SAS 1996).

Orchard	Total male moth captures in pheromone traps	CONFIRM 240F (1.0 litre)	ZOLONE FLO (2 litre)	ISOMATE-C (1000 units)	BASF (125 units)
# 1	63	N/A	0.10 ± 0.01a	1.60 ± 0.80a	1.10 ± 0.69a
# 2	46	2.10 ± 0.90a	N/A	N/A	2.00 ± 0.90a
# 3	70	0.60 ± 0.50a	N/A	N/A	2.10 ± 0.92a
# 4	11	0.10 ± 0.02a	N/A	N/A	0.10 ± 0.10a
# 5	57	0.60 ± 0.50a	N/A	N/A	0.60 ± 0.50a

1999 PMR REPORT # 16 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE #: 306-1261-9705

CROP: Apple, cv. McIntosh, Cortland and Red Delicious
PEST: Codling moth, *Cydia pomonella* (L), winter moth, *Operophtera brumata* (L)

NAME AND AGENCY:
SMITH R F[1], MAHAR A[1], RIGBY S[1], SHEFFIELD, C[2], O'FLAHERTY, C[1] and TROMBLEY, M[1]
[1]Agriculture and Agri-Food Canada, Atlantic Food & Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia, Canada, B4N 1J5
Tel: (902) 679-5730 Fax: (902) 679-2311Email: SmithR@em.agr.ca
[2] Department of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1

TITLE: COMPARISON OF INSECTICIDES FOR PROTECTION OF FRUIT AGAINST CODLING MOTH AND WINTER MOTH DAMAGE IN NOVA SCOTIA APPLE ORCHARDS

MATERIALS: ROHM & HAAS 2485 80WP (methoxfenozide), CONFIRM 240F (tebufenozide) , IMIDAN 50WP (phosmet), DIPEL WP (*Bacillus thuringiensis kurkstaki),*RIPCORD 400 EC (cypermethrin), COMPANION (Octyphenoxypolyethoxy -(9)-ethanol) agricultural adjuvant

METHODS: Codling moth: A 1.5 hectare orchard containing 14 year old semi-dwarf McIntosh' apples was the test site, ROHM & HAAS RH2485, CONFIRM 240F and IMIDAN 50WP were applied at 1000 mL, 300 g and 2000g respectively. Comparison combinations (Table 1) were randomly assigned to 25% portions of the orchard block and applied using a Solo® Master 412 gasoline powered mist blower delivering a 5x concentration of pesticide, using 600 litres of water per hectare. The agricultural adjuvant COMPANION was tank mixed (0.1% v/v) with RH2485 80WP.

Wing type pheromone traps baited with 1 mg codlemone were used to monitor codling moth abundance and seasonal flight profile in the plots. A predictive degree day model, a component of the Nova Scotia Apple Scab Monitoring Network (ASPEN) was used estimate • 3% egg hatch, at which point IMIDAN 50WP was applied (June 23rd), while CONFIRM 240F and RH2485 were applied at 200 • DD (June 18th). Cumulative monitoring trap captures reached 53 male moths by July 23rd, indicating economic losses would occur if no control measures were applied. Percent damaged fruit was determined by visual examination of 100 fruit on four randomly selected trees within each treatment plot.

Winter moth: Efficacy of products against winter moth were conducted in a 35 year old semi-dwarf orchard comprised of 'Red Delicious', 'Cortland' and 'McIntosh'. Pesticides were applied using a Solo® Master 412 gasoline powered sprayer at 'bud separation' stage (May 14th) when winter moth were in 1st-2nd instar. The DIPEL/RIPCORD tank mix application consisted of 560 g and 12.5 mL product respectively, IMIDAN at 4200 g, CONFIRM at 1000 mL and RH2485 (plus 0.1% COMPANION) per hectare, diluted equivalent to 600 L/ha. Three days post treatment ten fruit spur clusters infested with larvae were removed from each tree/plot, held for four days at 20• C and examined for larval mortality. Mortality values for winter moth were transformed as the arcsin[(proportion)$^{0.5}$] prior to ANOVA and separation of the means by Tukey's pairwise test (SAS 1996). Fruit injury data were transformed to (x)$^{0.5}$ prior to general linear model analysis and separation of the means by Least Significant Difference tests

(SAS 1996).

RESULTS: The following tables give fruit damage results from the pesticide evaluations conducted during 1999.

CONCLUSIONS: In Nova Scotia, those orchardists practising IPM tolerate 1-2% crop loss from codling moth and not more than 5% from all pests. CONFIRM 240F was applied as a single 1000 mL dose early in the flight of codling moth, which in 1999 spanned >60 days; this may explain the higher level of fruit injury. RH2485 80 WP proved highly effective limiting codling moth damage to < 1%, significantly better than all other products tested. Winter moth mortality ranged from 7-87% with CONFIRM and IMIDAN giving the best results. Fruit damage was reduced significantly by all pesticides except IMIDAN. Although damage was >1% in the RH2485, CONFIRM and DIPEL/RIPCORD plots the population of winter moth was very high and not typical of most commercial apple orchards in the Annapolis Valley.

Table 1. Percent fruit damage (mean ± SE) Aug 16th 1999 from larval feeding by codling moth. Within a row, mean values sharing a common letter are not significantly different (P=.05) (SAS 1996).

Treatment	Spray date	Percent fruit damage at harvest
no pesticide check	n/a	2.6 ± 1.0b
RH2485 80WP + COMPANION	June 18th	0.6 ± 0.5a
CONFIRM 240 F	June 18th	3.1 ± 1.1b
IMIDAN 50 WP	June 23rd	2.5 ± 1.3b

Table 2. Percent fruit damage (mean ± SE) and larval mortality of winter moth, seven days post treatment. Within a row, mean values sharing a common letter are not significantly different (P=.05) (SAS 1996).

Treatment	Percent fruit damage	Percent larval mortality
no pesticide check	6.60 ± 1.50a	7.20 ± 2.50d
RH2485 80WP + COMPANION	2.37 ± 0.91b	25.37 ± 5.00cd
CONFIRM 240 F	3.10 ± 1.05b	75.00 ± 5.05ab
IMIDAN 50 WP	3.60 ± 1.3ab	87.50 ± 2.50a
DIPEL WP + 10 % RIPCORD	2.10 ± 0.92b	47.50 ± 17.50bc

1999 PMR REPORT # 17 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE #: 306-1261-9705

CROP: Apple, cv. McIntosh
PEST: Codling moth, *Cydia pomonella* (L),

NAME AND AGENCY:
SMITH R F[1], RIGBY S[1], MAHAR, A[1], SHEFFIELD, C[2], O'FLAHERTY, C[1] and TROMBLEY, M[1]
[1]Agriculture and Agri-Food Canada, Atlantic Food & Horticulture Research Centre, 32 Main Street, Kentville, Nova Scotia, Canada, B4N 1J5
Tel: (902) 679-5730 Fax: (902) 679-2311 Email: SmithR@em.agr.ca
[2] Department of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1

TITLE: EVALUATION OF LAST CALL® 'BAIT AND KILL' FOR MANAGEMENT OF CODLING MOTH IN NOVA SCOTIA APPLE ORCHARDS.

MATERIALS: LAST CALL (E,E-8 10 dodecadien-1-ol, 51%, Dodecanol, 29.1%, tetradetanol, 6%, inert ingredients 13.1%, permethrin 6% w/w), ZOLONE FLO (phosalone)

METHODS: In a 3.0 ha apple orchard in the Annapolis Valley of Nova Scotia, Last Call® a 'bait and kill' codling moth control technique was tested as an alternative to conventional insecticides in protecting fruit from codling moth infestation and contrasted. Wing type pheromone traps baited with 1 mg codlemone were used to monitor codling moth abundance and seasonal flight profile in the orchard. A degree day model was used to predict • 3% egg hatch (ca. 250• DD post biofix) at which point ZOLONE FLO was applied.A Rittenhouse orchard mist sprayers delivering a 5x concentration of pesticide to apply ZOLONE FLO to 50% of the orchard block at the rate of 2 litres per hectare. Last Call® was applied May 28th at a rate of 3-5 droplets in the upper 25% canopy of each tree using an aerosol hand held applicator. Percent damaged fruit was determined by visual examination of all fruit on twelve trees per treatment, on September 5th 1999. Fruit injury data were transformed to • n prior to general linear model analysis and separation of the means by Least Significant Difference tests (SAS 1996).

RESULTS: Table 1 gives fruit damage results from the pesticide evaluations conducted during 1999.

CONCLUSIONS: In Nova Scotia, most orchardists practising IPM tolerate 1% crop loss from codling moth and not more than 5% from all pests. A single application of Last Call® gave satisfactory season-long protection, despite the fact that 1999 was an abnormally hot, dry year and a partial second generation of codling moth was encountered. The 'bait & kill' treatment proved as effective as the organophosphate ZOLONE FLO. It was relatively easy to treat the 2-3 metre high trees and one hectare was completed requiring less than one hour of labour.

Table 1. Percent fruit damage from larval feeding by codling moth (mean ± SE) September 5th 1999. Mean values sharing a common letter are not significantly different (P=.05) (SAS 1996).

Treatment	Injured fruit
untreated check	3.20 ± 1.30a
ZOLONE FLO	0.55 ± 0.25b
LAST CALL®	0.34 ± 0.15b

1999 PMR REPORT # 18 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE #: 306-1261-9705

CROP: Apple, cv. McIntosh
PEST: Codling moth, *Cydia pomonella*.

NAME AND AGENCY:
SMITH R F, MAHAR, A, RIGBY S, SHEFFIELD, C[1], O'FLAHERTY, C and TROMBLEY, M
Agriculture and Agri-Food Canada, Atlantic Food & Horticulture Research Centre,
32 Main Street, Kentville, Nova Scotia, Canada, B4N 1J5
Tel: (902) 679-5730 Fax: (902) 679-2311 Email: SmithR@em.agr.ca
[1] Department of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1

TITLE: ALTERNATIVES TO ORGANOPHOSPHATES TO PROTECT APPLES FROM CODLING MOTH DAMAGE IN ORCHARDS OF NOVA SCOTIA'S ANNAPOLIS VALLEY.

MATERIALS: Rhone-Poulene EXP61486A (acetamiprid) plus COMPANION (spreader/sticker), IMIDAN 50WP (phosmet), CONFIRM 240 F (tebufenozide)

METHODS: The test site was a 1.1 ha block of 12 year old apple, cv. McIntosh 'Summerland' strain at the Atlantic Food & Horticulture Research Centre, Kentville, Nova Scotia. Wing type pheromone traps baited with 1 mg codlemone were used to monitor codling moth phenology and were set May 30th within the block. A predictive degree day model was used to determine • 3% egg hatch and to time applications.

On June 21st treatments against codling moth were applied (Table 1) using a Solo® Master 412 gasoline powered mist blower delivering a 5x concentration of pesticide (600 litres water per hectare). Fruit injury assessments were conducted on 50 fruit from each of four trees per treatment to resolve level of fruit protection from codling moth larvae attack. Phytotoxicity was assessed by examination of 10 leaves on each of four trees within each treatment and numerically rated from 0 (no phytotoxicity) to 10 (severe phytotoxicity). Damage data was transformed to arcsin (square root of proportion) prior to analysis of variance and separation of the means was by Least Significant Difference tests (SAS 1996).

RESULTS: See Table1.

CONCLUSIONS: EXP61486A at 87 and 120 gram rates both gave acceptible levels of fruit protection from codling moth (i.e. ca < 1.0% crop loss), and was significantly better than CONFIRM and IMIDAN. This was achieved despite an extended codling moth flight activity period in a year of abnormally high heat unit accumulation.

Table 1. Percent (mean ± SE) fruit damage from codling moth and rated level of phytotoxicity from select pesticide applications. Bracketed values are product ai application rate per hectare unless specified otherwise. Within a column mean values sharing a common letter are not significantly different (P= 0.1) (SAS 1996, Least Significant Difference test).

	% fruit damage	Phytotoxicity (0-10)
Untreated check	3.1 ± 1.1a	0
EXP61486A (47 g)	2.6 ± 1.2ab	0
EXP61486A (85 g)	1.1 ± 0.7bc	0
EXP61486A (120 g)	0.6 ± 0.5c	0
IMIDAN 50WP (2.1 kg)	2.5 ± 1.2ab	0
CONFIRM 240 (500 mL)	3.1 ± 1.1ab	0
Grand Mean ± SE	2.0 ± 0.3	n/a

1999 PMR REPORT # 19 **SECTION A: INSECT PESTS OF FRUIT**

CROP: Grapes cv. Pinot Gris

PEST: Western Grape Leafhopper, *Erythroneura elegantula* Osborn
Virginia Creeper Leafhopper, *Erythroneura ziczac* Walsh

NAME AND AGENCY:
PHILIP HG and LASHUK CL
BC Ministry of Agriculture and Food, 200-1690 Powick Rd, Kelowna, BC V1X 7G5
Tel: (250) 861-7211 Fax: (250) 861-7490 E-mail: Hugh.Philip@gems8.gov.bc.ca

TITLE: EFFICACY OF IMIDACLOPRID, ACETAMIPRID AND AGRI-50 AGAINST WESTERN GRAPE LEAFHOPPER AND VIRGINIA CREEPER LEAFHOPPER

MATERIALS: ADMIRE 240 F (imidacloprid), Acetamiprid (70% WP), SEVIN XLR PLUS (carbaryl 44.1% liquid suspension), AGRI-50 (2% sodium lauryl sulfate)

METHODS: The trial was conducted near Penticton, BC in a commercial vineyard of non-bearing 2 year old vines spaced 1.0 m by 3.1 m. Inspection of the vineyard on August 25th revealed the presence of both the Virginia creeper (VCL) and western grape (WGL) leafhoppers. The candidate products were applied on 31 August between 0800 and 1200 to the point of run-off (approximately 3.3 L of spray mixture per plot) using a Backpak 20 sprayer with an E04-80 nozzle. Treatments were replicated three times and assigned to five-vine plots in a randomized complete block design (three adjacent rows). Care was taken to avoid spray drift between plots. ADMIRE 240 F was applied at rates of 0.7g and 0.94g AI/10 L; acetamiprid 70% WP at 1.0 and 2.0 g AI/10L; AGRI-50 at 0.67 g AI/10L; and SEVIN XLR PLUS, the standard treatment, was sprayed at a rate of 6.6 g AI/10L. The check plots were sprayed with water. Plots were sampled immediately prior to treatment (30 August), and at 3 and 10 days post treatment (3 September and 10 September, respectively). 10 leaves from the middle 3 vines per plot were collected and returned to the lab where they were examined with a stereomicroscope for the presence of live nymphs. Adults were not monitored due to the small size of the plots. The presence of live *Anagrus daanei*, an egg parasitoid of leafhoppers, in samples collected 10 DAT were also recorded. The data was analyzed using ANOVA and the mean number of live nymphs recorded/treatment replicate on each sampling date was compared using Bartlett's test (p=0.05).

RESULTS: Table 1 shows the total number of live nymphs found in collections of 30 leaves (10 leaves from each of three replicates) per treatment per sample date. The dramatic drop in nymphal numbers in the check plots may have been a result of the 5th instar nymphs molting into adults. The only significant difference among treatments occurred at 3 and 10 DAT for VCL. Adult *Anagrus daanei* were recovered from all treatments sampled at 10 DAT (check, 13; carbaryl, 2; imidacloprid low rate, 10; imidacloprid high rate, 8; acetamiprid low rate, 3; acetamiprid high rate, 1; sodium lauryl sulfate, 35). These differences in total parasitoids recovered suggest variation among the products in toxicity to the parasitoid at the rates tested. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: The low numbers of leafhopper nymphs recovered in all the plots do not allow any firm conclusions on the efficacy of imidacloprid and acetamiprid against VCL and WGL nymphs. However, both rates of acetamiprid (1 and 2 g AI/10 L) and the high rate of imidacloprid (0.94 g AI/10 L) performed as well as the standard carbaryl applied at 6.6 g AI/10 L. The low rate of imidacloprid (0.7 g AI/10 L) and sodium lauryl sulfate did not reduce the number of nymphs of either species much below that of the check plots.

Table 1. Total number of live Virginia Creeper Leafhopper (VCL) and Western Grape Leafhopper (WGL) nymphs on untreated vines and vines treated with ADMIRE 240F, acetamiprid 70 % WP, AGRI-50 and SEVIN XLR PLUS.

Treatment and Rate (g AI/10 L)	Rate (g AI/ha)	Sampling Date 30 August		3 September (3 DAT)		13 September (10 DAT)	
		VCL	WGL	VCL	WGL	VCL	WGL
Check	-	21	9	2	0	8	5
Carbaryl (6.6)	1405.2	15	9	0	0	0	0
Acetamiprid (1.0)	212.9	17	7	0	0	0	0
Acetamiprid (2.0)	425.8	31	13	0	0	0	0
Imidacloprid (0.7)	149.0	30	22	4	1	1	5
Imidacloprid (0.94)	200.0	22	5	0	0	0	0
Sodium Lauryl Sulfate (0.67)	142.6	41	15	4	0	6	3
ANOVA (**p<0.05)		ns	ns	**	ns	**	ns

1999 PMR REPORT # 20 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Grapes cv. Concord
PEST: Grape Leafhopper, *Erythroneura comes* (Say)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF GRAPE LEAFHOPPER ON GRAPE WITH INSECTICIDES - 1999

MATERIALS: ADMIRE 240 F (imidacloprid), GUTHION 240 SC (azinphos-methyl)

METHODS: The trial was conducted in a mature vineyard in the Jordan, Ontario area; vines cv. Concord were spaced 2.7 m by 2.7 m. Treatments were replicated four times and assigned to three-vine plots, and arranged according to a randomised complete block design. Blocks were sampled pre-treatment, and individual plots sampled 3 days after treatment. Samples consisted of counts made on 20 leaves per plot, picked randomly from both sides of the row. Leaves were examined using a stereomicroscope, and numbers of living grape leafhopper (GLH) nymphs recorded. On 16 July, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 8-9 L of spray mix were used per plot; pressure was set at 2000 kPa. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in Table 1. Pre-treatment samples 15 July showed similar numbers of GLH nymphs (approximately 5 nymphs per leaf) in all plots. Due to extremely high temperatures, all GLH nymphs had developed to the adult stage before a second sample could be conducted. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the 3 day sample, numbers of nymphs in all of the treated plots were significantly lower than the control.

Table 1. Number of GLH nymphs per leaf.

Treatment[1]	Rate a.i./ha	Number of Nymphs 3 days after treatment (19 July)
ADMIRE 240 F	48.0 g	0.13 b[2]
ADMIRE 240F	38.4 g	0.60 b
GUTHION 240 SC	0.75 kg	0.17 b
CONTROL	-	3.10 a

[1] Applied 16 July
[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 21 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Peach cv. Loring
PEST: Oriental Fruit Moth, *Grapholita molesta* (Busck)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: ASSESSMENT OF INSECTICIDES AGAINST ORIENTAL FRUIT MOTH ON PEACH - 1999

MATERIALS: DECIS 5 EC (deltamethrin), GUTHION 50 WP (azinphos-methyl), IMIDAN 50 WP (phosmet), ORTHENE 75 SP (acephate)

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Loring were spaced 4.6 m by 5.5 m. Treatments were replicated four times and assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for second generation, determined from pheromone trap catches of male moths. Treatments were applied 2 July (6 days after trap catch upswing), and repeated 12 days later (14 July). ORTHENE was applied as two treatments at two different rates, 562.5 g ai/ha and 750 g ai/ha. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 10-11 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled post-treatment 22 July; all infested terminals and fruit were removed, and examined for the presence of live larvae. Efficacy ratings were expressed as total damage, consisting of the total number of infested terminals and peaches. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in table 1 below. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the 22 July sample, only the DECIS treatment showed a significant difference from the control (Table 1). Infestations were considered severe.

Table 1. Total OFM damage per plot[1]

Treatment	Rate (a.i./ha)	Total Damage (22 July)
DECIS 5 EC[2]	10.0 g	79.0 b[3]
GUTHION 50 WP	1.0 kg	103.2 ab
IMIDAN 50 WP	3.75 kg	160.0 ab
ORTHENE 75 SP	562.5 g	153.0 ab
ORTHENE 75 SP	750.0 g	191.2 ab
CONTROL	-	207.0 a

[1] Total Damage = # infested terminals + # damaged fruit

[2] Applied 2 July, 14 July

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 22 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Peach cv. Loring
PEST: Oriental Fruit Moth, *Grapholita molesta* (Busck)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF ORIENTAL FRUIT MOTH ON PEACH WITH VARIOUS INSECTICIDES - 1999

MATERIALS: MATADOR 120 EC (lambda cyhalothrin), RH 2485 80 WP

METHODS: The trial was conducted in a three-year-old orchard in the Jordan Station, Ontario area; trees cv. Loring were spaced 4.6 m by 5.5 m. Treatments were replicated four times and assigned to two-tree plots, and arranged according to a randomised complete block design. Application was timed for second generation, determined from pheromone trap catches of male moths. Treatments were applied 2 July, 660 DD (base 7.2 C) after first male moth catch, and repeated 12 days later (14 July). RH 2485 was applied as two treatments at different rates, 240 g ai/ha and 360 g ai/ha; the spreader/sticker AGRAL 90 was added to both treatments at 0.1% of the total spray mix. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 10-11 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled post-treatment 22 July; all infested terminals and fruit were removed, and examined for the presence of live larvae. Efficacy ratings were expressed as total damage, consisting of the total number of infested terminals and peaches. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: See Table 1. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: In the 22 July sample, only the MATADOR treatment showed a significant difference from the control. Infestations were considered severe.

Table 1. Total OFM damage per plot[1]

Treatment	Rate (a.i./ha)	OFM Damage (22 July)
MATADOR 120 EC[2]	12.5 g	130.0 B[3]
RH 2485 80 WP + AGRAL 90	240.0 g	198.7 A
RH 2485 80 WP +AGRAL 90	360.0 g	157.0 A
CONTROL	-	218.7 A

[1] Total Damage = # infested terminals + # damaged fruit
[2] Applied 2 July, 14 July
[3] Numbers followed by the same letter are not significantly different P<0.05, Tukey test.

1999 PMR REPORT # 23 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Pear cv. Bosc
PEST: Pear Psylla, *Psylla pyricola* (Foerster)
Plum Curculio, *Conotrachelus nenuphar* (Herbst)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF PEAR PSYLLA AND PLUM CURCULIO WITH THIAMETHOXAM - 1999

MATERIALS: ACTARA 25 WG (thiamethoxam), GUTHION 50 WP (azinphos-methyl)

METHODS: The trial was conducted in a twenty-year-old orchard in the Beamsville, Ontario area; trees cv. Bosc were spaced 5.4 m by 6.0 m. Treatments were replicated four times and assigned to one-tree plots, and arranged according to a randomised complete block design. Treatments were applied at petal fall (21 May); one program included a second application (31 May) of ACTARA at the 79 g ai/ha rate. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 9-10 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled pre-treatment 19 May, and twice post-treatment, 31 May and 10 June (10 and 20 days after treatment). Efficacy ratings consisted of counts of nymphs of pear psylla (PP) on 20 leaf clusters per plot picked randomly; clusters were examined using a stereomicroscope and numbers of live PP nymphs were recorded. Efficacy versus plum curculio (PC) was also rated; 25 pears per plot were picked randomly, and fruit was examined for PC damage. Data were transformed (log x+1) and analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. Prespray samples 19 May showed similar numbers of psylla nymphs (approximately 2 nymphs per cluster) in all plots. No phytotoxic effects were observed in any plots.

CONCLUSIONS: Numbers of psylla nymphs per cluster in all treated plots were significantly lower than the control in the 10 day sample (Table 1); only the 96 g ai/ha and replicated application of 79 g ai/ha ACTARA treatments were significantly different from the control in the 20 day sample. The treatment with a second application of ACTARA was not better than those with a single application of ACTARA. All treatments showed levels of PC damage significantly lower than the control in the 10 day sample (Table 2); however, none of the treatments were significantly different from the control in the 20 day sample.

Table 1. Numbers of pear psylla nymphs per cluster.

Treatment	Rate (a.i./ha)	Days After Initial Application	
		10 days (31 May)	20 days (10 June)
ACTARA 25 WG[1]	79 g	0.05 b[3]	0.3 b
ACTARA 25 WG[2]	96 g	0.20 b	0.6 b
ACTARA 25 WG[2]	79 g	0.13 b	1.1 ab
GUTHION 50 WP[2]	1.05 kg	0.33 b	1.1 ab
CONTROL	-	2.30 a	2.7 a

[1] Applied 21 May, second application 31 May

[2] Applied 21 May

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by plum curculio.

Treatment	Rate (a.i./ha)	Days After Initial Application	
		10 days (31 May)	20 days (10 June)
ACTARA 25 WG[1]	79 g	2.1 b[3]	9.3 a
ACTARA 25 WG[2]	96 g	3.6 b	4.7 a
ACTARA 25 WG[2]	79 g	2.6 b	1.9 a
GUTHION 50 WP[2]	1.05 kg	6.8 b	3.1 a
CONTROL	-	12.6 a	8.8 a

[1] Applied 21 May, second application 31 May

[2] Applied 21 May

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 24 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Pear cv. Bosc
PEST: Pear Psylla, *Psylla pyricola* (Foerster)
Plum Curculio, *Conotrachelus nenuphar* (Herbst)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: ASSESSMENT OF INSECTICIDES AGAINST PEAR PSYLLA AND PLUM CURCULIO - 1999

MATERIALS: ACTARA 25 WG (thiamethoxam), DECIS 5 EC (deltamethrin)

METHODS: The trial was conducted in a fifteen-year-old orchard in the Jordan, Ontario area; trees cv. Bosc were spaced 5.4 m by 6.0 m. Treatments were replicated four times and assigned to two-tree plots, and arranged according to a randomised complete block design. Treatments were applied at petal fall (27 May); one program included a second application (8 June) of ACTARA at the 79 g ai/ha rate. Insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 9-10 L of spray mix were used per plot; pressure was set at 2000 kPa. Plots were sampled pre-treatment 25 May, and three times post-treatment, 1 June, 8 June, and 17 June (5, 12 and 21 days after initial treatment). Efficacy ratings consisted of counts of nymphs of pear psylla (PP) on 20 leaf clusters per plot picked randomly; clusters were examined using a stereomicroscope and numbers of live PP nymphs were recorded. Efficacy versus plum curculio (PC) was also rated; 25 pears per plot were picked randomly, and fruit was examined for PC damage. Data were transformed (square root $(X + 0.5)$) and analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2. Prespray samples 25 May showed similar numbers of psylla nymphs (approximately 6.0 nymphs per cluster) in all plots. No phytotoxic effects were observed in any plots.

CONCLUSIONS: Numbers of psylla nymphs per cluster in all treated plots were significantly lower than the control in the 5 day sample (Table 1); all plots treated with ACTARA showed significantly fewer psylla nymphs per cluster than the DECIS standard five days and 12 days after application. All ACTARA treatments were significantly different from the control in the 12 day sample whereas the DECIS standard was not; by 21 days after initial application, only the 96 g ai/ha treatment and the two application treatment of ACTARA at 79 g ai/ha were significantly different from the control. All treatments showed levels of PC damage significantly lower than the control in the 5 day sample (Table 2); however, none of the treatments were significantly different from the control in the 12 day sample, possibly due to plot-to-plot variation in infestations.

Table 1. Numbers of pear psylla nymphs per cluster.

Treatment	Rate (a.i./ha)	Days After Initial Application		
		5 days (1 June)	12 days (8 June)	21 days (17 June)
ACTARA 25 WG[1]	79 g	0.3 c[3]	0.2 b	0.7 c
ACTARA 25 WG[2]	96 g	0.4 c	0.6 b	1.1 bc
ACTARA 25 WG[2]	79 g	0.6 c	0.3 b	1.8 ab
DECIS 5EC[2]	17.5 g	3.9 b	0.9 a	2.2 ab
CONTROL	-	8.2 a	3.4 a	3.6 a

[1] Applied 21 May, second application 31 May

[2] Applied 21 May

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by plum curculio.

Treatment	Rate (a.i./ha)	Days After Initial Application	
		5 days (1 June)	12 days (8 June)
ACTARA 25 WG[1]	79 g	1.9 b[3]	2.5 a
ACTARA 25 WG[2]	96 g	2.6 b	5.2 a
ACTARA 25 WG[2]	79 g	0.6 b	7.3 a
DECIS 5EC[2]	17.5 g	0.7 b	3.8 a
CONTROL	-	16.9 a	9.8 a

[1] Applied 21 May, second application 31 May

[2] Applied 21 May

[3] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 25 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Pear cv. Bartlett
PESTS: Pear Psylla, *Psylla pyricola* (Foerster)
Plum Curculio, *Conotrachelus nenuphar* (Herbst)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF PEAR PSYLLA ON PEAR WITH INSECTICIDES - 1999

MATERIALS: PYRAMITE 75 WP (pyridaben), MITAC 50 W (amitraz)

METHODS: The trial was conducted in a seven-year-old orchard in the Jordan, Ontario area; trees cv. Bartlett were spaced 5.4 m by 6.0 m. Treatments were replicated four times and assigned to two-tree plots, and arranged according to a randomised complete block design. Plots were sampled pre-treatment 25 May, and three times post-treatment, 1 June, 8 June, 17 June, and 23 June (5, 12, 21, and 27 days after treatment). Efficacy ratings consisted of counts of nymphs of pear psylla (PP) on 20 clusters per plot, picked randomly. Clusters were examined using a stereomicroscope and numbers of live PP nymphs were recorded. Fruit from each cluster were also examined for plum curculio (PC) damage. On 27 May, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 9-10 L of spray mix were used per plot; pressure was set at 2000 kPa. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in tables 1 and 2 below. Prespray samples 25 May showed similar numbers of psylla nymphs (approximately 6.0 nymphs per cluster) in all plots. No phytotoxic effects were observed in any of the plots.

CONCLUSIONS: Numbers of psylla nymphs per cluster in all treated plots were significantly lower than the control in of the 5 day samples (Table 1); the MITAC treated plots showed significantly fewer psylla nymphs than all PYRAMITE treated plots. The 225 g ai/ha and 450 g ai/ha treatments were not significantly different from the control in the 12 day sample; however, the 560 g ai/ha MITAC treatments were significantly different from the control, but were not significantly different from the 450 g ai/ha treatment. The 225 g ai/ha treatment was not significantly different from the control in the 21 day sample; numbers of psylla nymphs in these plots were not significantly different from the other treated plots. By 27 days after application, only the plots treated with MITAC and the 560 g ai/ha rate of PYRAMITE were significantly different from the control; numbers of psylla in the plots treated with this rate of PYRAMITE were not significantly different from the 225 g ai/ha or 450 g ai/ha rates. None of the treated plots had significantly lower PC damage than the control in the 5 or 12 day samples (Table 2).

Table 1. Numbers of pear psylla nymphs per cluster.

Treatment[1]	Rate (a.i./ha)	Days After Treatment			
		5 days (1 June)	12 days (8 June)	21 days (17 June)	27 days (23 June)
MITAC 50 WP	1.25 kg	0.1 c[2]	0.1 c	0.2 b	0.2 c
PYRAMITE 75 WP	560 g	1.4 b	0.3 c	1.2 b	0.6 bc
PYRAMITE 75 WP	450 g	2.0 b	0.5 bc	1.2 b	1.8 ab
PYRAMITE 75 WP	225 g	2.7 b	2.3 a	2.4 ab	3.9 a
CONTROL	-	6.4 a	2.0 ab	4.0 a	2.2 ab

[1] Applied 27 May

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

Table 2. Percent fruit damaged by plum curculio.

Treatment[1]	Rate (a.i./ha)	Days After Treatment	
		5 days (1 June)	12 days (8 June)
MITAC 50 WP	1.25 kg	4.4 a[2]	3.8 a
PYRAMITE 75 WP	560 g	0.0 a	9.7 a
PYRAMITE 75 WP	450 g	3.6 a	3.6 a
PYRAMITE 75 WP	225 g	2.9 a	5.3 a
CONTROL	-	6.6 a	5.6 a

[1] Applied 27 May

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 26 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Pear cv. Bartlett
PEST: Pear Psylla, *Psylla pyricola* (Foerster)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: ASSESSMENT OF PYRIDABEN AGAINST PEAR PSYLLA - 1999

MATERIALS: PYRAMITE 75 WP (pyridaben), MITAC 50 W (amitraz)

METHODS: The trial was conducted in a fifteen-year-old orchard in the St. Catharines, Ontario area; trees cv. Bartlett were spaced 5.4 m by 6.0 m. Treatments were replicated four times and assigned to one-tree plots, and arranged according to a randomised complete block design. Plots were sampled pre-treatment 17 June, and twice post-treatment, 25 June and 5 July (7 and 17 days after treatment). Efficacy ratings consisted of counts of nymphs of pear psylla (PP) on 20 clusters per plot, picked randomly. Clusters were examined using a stereomicroscope and numbers of live PP nymphs were recorded. On 18 June, insecticides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 9-10 L of spray mix were used per plot; pressure was set at 2000 kPa. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in table 1 below. Prespray samples 17 June showed similar numbers of psylla nymphs (approximately 4 nymphs per cluster) in all plots. No phytotoxic effects were observed in any plots.

CONCLUSIONS: Numbers of psylla nymphs per cluster in all treated plots were significantly lower than the control in of the 7 day samples (Table 1); however, none of the treatments were significantly different from the control in the 17 day samples. The psylla population declined sharply prior to the 5 July sample as the host trees were stressed by extreme heat and drought.

Table 1. Numbers of pear psylla nymphs per cluster.

Treatment[1]	Rate (a.i./ha)	Days After Treatment	
		7 days (25 June)	17 days (5 July)
MITAC 50 WP	1.25 kg	0.7 b[2]	0.04 a
PYRAMITE 75 WP	560 g	2.0 b	0.19 a
PYRAMITE 75 WP	450 g	1.3 b	0.10 a
PYRAMITE 75 WP	225 g	1.7 b	0.16 a
CONTROL	-	4.6 a	0.30 a

[1] Applied 18 June

[2] Numbers followed by the same letter are not significantly different $P<0.05$, Tukey test.

1999 PMR REPORT # 27 **SECTION A: INSECT PESTS OF FRUIT**
STUDY DATA BASE: 280-1261-9341

CROP: Pear cv. Bosc
PEST: Pear Rust Mite, *Epitrimerus pyri* (Nalepa)

NAME AND AGENCY:
POGODA, M K and PREE, D J
Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
4902 Victoria Ave. North, P.O. Box 6000, Vineland, ON, L0R 2E0
Tel: (905) 562-4113 Fax: (905) 562-4335 E-mail: pogodam@em.agr.ca

TITLE: CONTROL OF PEAR RUST MITE ON PEAR WITH ACARICIDES - 1999

MATERIALS: KELTHANE 50 W (dicofol), PYRAMITE 75 WP (pyridaben)

METHODS: The trial was conducted in a twenty-year-old orchard in the Beamsville, Ontario area; trees cv. Bosc were spaced 5.4 m by 6.0 m. Treatments were replicated four times and assigned to one-tree plots separated by guard trees, and arranged according to a randomised complete block design. Plots were sampled pre-treatment 11 August, and three times post-treatment, 18 August, 25 August, and 1 September (7, 14, and 21 days after treatment), and consisted of counts made on 25 leaves per plot, picked randomly at arm's length into the canopy. Leaves were examined using a stereomicroscope and assigned a rating based on numbers of live pear rust mite (PRM); individual leaves were given a rating of 0 (zero PRM/leaf); 1 (1-10 PRM/leaf); 2 (11-25 PRM/leaf); 3 (26-50 PRM/leaf); 4 (51-100 PRM/leaf); or 5 (101+ PRM/leaf). On 11 August, acaricides were diluted to a rate comparable to 3000 L per ha, and sprayed to runoff with a Rittenhouse truck-mounted sprayer equipped with a Spraying Systems handgun fitted with a D-6 orifice plate. Approximately 9-10 L of spray mix were used per plot; pressure was set at 2000 kPa. Data were analysed using analysis of variance and means separated with a Tukey Test at the 0.05 significance level.

RESULTS: Data are presented in the table below. Prespray samples 11 August showed similar numbers of PRM in all plots, with an average rating of approximately 1.0 (1-10 PRM/leaf). No phytotoxic effects were observed in any of the treated plots. Numbers of PRM were observed to build through August and decline naturally into September.

CONCLUSIONS: Numbers of PRM in both the PYRAMITE and KELTHANE treated plots were significantly lower than the control in each of the 7, 14, and 21 day samples (Table 1). The PYRAMITE treatments were not significantly different from the KELTHANE treatment in any of the samples.

Table 1. Average pear rust mite (PRM) rating[1].

Treatment[2]	Rate a.i./ha	Days After Treatment			
		Prespray 11 Aug	7 days 18 August	14 days 25 August	21 days 1 September
KELTHANE 50 W	1.6 kg	1.2 a[3]	0.08 b	0.21 b	0.24 b
PYRAMITE 75 WP	450 g	0.9 a	0.09 b	0.07 b	0.12 b
PYRAMITE 75 WP	225 g	0.7 a	0.05 b	0.13 b	0.33 b
CONTROL	-	0.8 a	2.00 a	2.85 a	2.69 a

[1] PRM Rating: 0 = 0; 1 = 1-10; 2 = 11-25; 3 = 26-50; 4 = 51-100; 5 = 100+

[2] Applied 11 August

[2] Numbers in the same column followed by the same letter are not significantly different P<0.05, Tukey test.

1999 PMR REPORT # 28 **SECTION A: INSECTS OF BERRY CROPS**
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
PEST: Choke cherry midge, *Contarinia virginianae* Felt.

NAME AND AGENCY:
NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A., Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284 Fax: (306) 695-2568 E-mail: neillb@em.agr.ca

TITLE: EVALUATION OF PRODUCTS FOR CONTROL OF CHOKE CHERRY MIDGE ON CHOKE CHERRY AT TWO SITES IN SASKATCHEWAN, IN 1998.

MATERIALS: DECIS 5 EC (deltamethrin 5% EC), MATADOR 120 EC (cyhalothrin-lambda 12% EC) and SEVIN XLR PLUS (carbaryl 48% LS).

METHODS: Choke cherry fruit infested by the choke cherry midge (CCM) appears as enlarged, pear-shaped galls. Damage by the midge results in unusable fruit and non-viable seed. This trial was conducted to determine if an insecticide applied after flowering would control CCM and increase fruit production. Three insecticides and a water applied control were evaluated for control of the CCM at two sites. The trials were conducted on a 13-year-old, single row choke cherry shelterbelt located on the PFRA Shelterbelt Centre, Indian Head, Saskatchewan (SW 11-18-13-W2) and on a ten-year-old, single row choke cherry shelterbelt located on the Les Williams farm (NW 30-13-8-W2) near Glenavon, Saskatchewan. At the Indian Head site, treatments plots were eight metres long with a two metre buffer between plots. At the Glenavon site, treatments plots were 7.5 metres long with a two metre buffer between plots. All plants were spaced 0.75 metres apart within the row. At both sites, the four treatments were replicated five times in a randomized complete block design.

Treatments were applied on May 31, 1998 at the Indian Head site and on June 2, 1998 at the Glenavon site. Treatments were applied using a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m^2 of plant surface area. Treatments were applied to both sides of the shelterbelt until the foliage was wet but not dripping. At the time of application, the plants were fully leafed out and flowering was complete. The majority of the choke cherry flowered from May 22 to May 26, 1998.

Assessment of CCM populations were conducted on July 3 at the Indian Head site which was 33 days after treatment (DAT) and on July 7 at the Glenavon site (35 DAT), by randomly collecting 80 racemes per plot (40 from each side) and recording the number of midge infested berries and the number of healthy berries per raceme. Plant phytotoxicity assessments were taken on July 3 at the Indian Head site and on July 7 at the Glenavon site.

Mature fruit was collected to determine if insecticide application had an impact on fruit set. The assessment was conducted by collecting 100 racemes from each plot (50 from each side) and recording the number of healthy berries per raceme. These assessments were conducted on August 24 at the Indian Head site (85 DAT) and on August 26 at the Glenavon site (85 DAT). A two-way ANOVA was conducted with means separated by the Duncan's Multiple Range Test. Fruit was collected from each plot for insecticide residue analysis.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS, MATADOR or SEVIN. Insecticide treatments did not have a significant impact on CCM populations at either site (Table 1). Insecticide application did not significantly affect the number of healthy fruit produced per raceme at either site on either assessment date. Plant variability in fruit set and CCM susceptibility may have masked treatment differences.

CONCLUSIONS: The incidence of CCM galls was not reduced by insecticide application nor was fruit set improved by insecticide application. Earlier application dates should be tested for CCM control since we suspect that the berries had already been infested by the CCM before treatments were applied in 1998.

Table 1. Evaluation of products for control of choke cherry midge at two sites, Saskatchewan in 1998.

	Rate of product		Midge infested galls / plot		Healthy berries/ raceme Glenavon		Healthy berries/ raceme Indian Head	
Treatment	L/ha	L/1000 L	Glen.	I.H.	Jul. 7	Aug. 26	Jul. 3	Aug.24
DECIS 5EC	0.2	0.092	14.6 a[1]	41.4 a	7.37 a	6.59 a	10.17 a	6.63 a
MATADOR 120EC	0.13	0.058	47.6 a	45.8 a	8.26 a	7.84 a	9.68 a	7.49 a
SEVIN XLR PLUS	2.3	1.058	21.4 a	54.4 a	7.48 a	6.43 a	10.34 a	6.75 a
Water check	-	-	30.0 a	55.6 a	9.99 a	7.39 a	8.14 a	6.10 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 29 **SECTION A: INSECTS OF BERRY CROPS**
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
PEST: Ugly nest caterpillar, *Archips cerasivorana* (Fitch).

NAME AND AGENCY:
NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284; **Fax:** (306) 695-2568; **E-mail:** neillb@em.agr.ca

TITLE: EVALUATION OF PRODUCTS FOR CONTROL OF UGLY NEST CATERPILLAR ON CHOKE CHERRY AT TWO SITES IN SASKATCHEWAN, IN 1998.

MATERIALS: DECIS 5 EC (deltamethrin 5% EC), DIPEL WP (*Bacillus thuringiensis* var. *kurstaki*), MATADOR 120 EC (cyhalothrin-lambda 12% EC), SEVIN XLR PLUS (carbaryl 48% LS).

METHODS: The ugly nest caterpillar (UNC) is a common tent-forming defoliator of choke cherry on the Canadian prairies. Although the UNC does not feed directly on the fruit of choke cherry, infestations may cause reduced vigour of fruit-bearing plants. Four insecticides and a water check were evaluated for control of this insect at two sites. The first site was located at the Albert Bugiera farm (SW 31-17-12-W2) and consisted of a nine-year-old, single row shelterbelt planted in the following design: one green ash and one choke cherry. Treatment plots were ten metres in length with a 2.5 metre buffer between plots. Each treatment plot contained at least one UNC tent. The second site was located at Rosin Farms (NE 9-18-13-W2) and consisted of a seven-year-old, single row shelterbelt planted in the following design: three choke cherry, one green ash, three caragana and one green ash. Treatment plots at this site consisted of six choke cherry plants per plot containing at least one UNC tent. All plants were at a 0.75 metre spacing within the row. Both trials were set up in a randomized complete block design with five replications.

Treatments were applied on June 5, 1998 with a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m^2 of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the shelterbelt. At the time of application the plants were fully leafed, flowering was complete and fruit development had been initiated. The majority of the choke cherry flowered May 22 to May 26, 1998.

Plant phytotoxicity assessments were taken on June 12, 1998. Assessment of UNC larval populations occurred on June 12 at Bugiera's which was seven days after treatment (DAT) and on June 22 (17 DAT) at Rosin's, by removing all UNC tents (to a maximum of ten) from each treatment plot and counting the number of live larvae per tent (to a maximum of one hundred). Analysis of variance (ANOVA) was conducted using General Linear Model with the means separated by the Duncan's Multiple Range Test. Fruit samples were not taken for residue testing because insufficient fruit was produced on these plants.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS, DIPEL, MATADOR or SEVIN. There was no significant difference in the number of UNC tents per plot at either site, indicating a uniform pretreatment population of UNC (Table 1). At 7 DAT at the Bugiera farm, DECIS, MATADOR and SEVIN significantly reduced the UNC population per tent compared to DIPEL and the water check. At 17 DAT at the Rosin farm, DECIS, MATADOR and SEVIN significantly reduced the UNC population per tent compared to DIPEL and the water check, and DIPEL significantly reduced the UNC population per tent compared to the water check. The variation in effectiveness of DIPEL between sites may have been due to different post-treatment evaluation dates (7 DAT verses 17 DAT).

CONCLUSIONS: DECIS, MATADOR or SEVIN applied as a foliar spray to choke cherry after flowering and when damage by UNC was first noticed, effectively controlled UNC populations. DIPEL was effective in reducing UNC populations 17 DAT. Increased rates of DIPEL should be evaluated.

Table 1. Number of ugly nest caterpillar larvae per tent on choke cherry seven days after treatment (Bugiera's) and 17 days after treatment (Rosin's) with insecticide at two sites in Saskatchewan in 1998.

	Rate of product		Bugiera farm		Rosin farm	
Treatment	/ha	/1000 L	Tents / plot	UNC larvae / tent	Tents / plot	UNC larvae / tent
DECIS 5EC	0.200 L	0.092 L	7.8 a[1]	6.1 b	10.0 a	0.9 c
DIPEL WP	1.250 kg	0.575 kg	8.6 a	61.0 a	9.8 a	28.9 b
MATADOR 120 EC	0.125 L	0.058 L	6.2 a	0.8 b	6.8 a	0.0 c
SEVIN XLR PLUS	2.300 L	1.058 L	3.8 a	5.3 b	9.8 a	4.9 c
Water check	-	-	6.4 a	75.8 a	9.5 a	74.4 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 30 SECTION A: INSECTS OF BERRY CROPS
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
PEST: Prairie tent caterpillar, *Malacosoma californicum lutescens* (Neumoegen & Dyar)

NAME AND AGENCY:
NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284 Fax: (306) 695-2568 E-mail: neillb@em.agr.ca

TITLE: EVALUATION OF PRODUCTS FOR CONTROL OF PRAIRIE TENT CATERPILLAR ON CHOKE CHERRY AT TWO SITES IN SASKATCHEWAN, IN 1998.

MATERIALS: DECIS 5 EC (deltamethrin 5% EC), DIPEL WP (*Bacillus thuringiensis* var. *kurstaki*), MATADOR 120 EC (cyhalothrin-lambda 12% EC), SEVIN XLR PLUS (carbaryl 48% LS).

METHODS: The prairie tent caterpillar (PTC) is a common tent-forming defoliator of choke cherry on the Canadian prairies. Although PTC does not feed directly on the fruit of choke cherry, infestations may cause reduced vigour of fruit-bearing plants. Four insecticides and a water check were evaluated for control of this insect at two sites. The first site was located at the Lyle Alspach farm (NW 12-18-13-W2) and consisted of a six-year-old, single row shelterbelt planted in the following design: three choke cherry, one green ash, three caragana and one green ash. Treatment plots at this site consisted of three choke cherry plants per plot containing at least one prairie tent caterpillar nest. The second site was located at the Albert Bugiera farm (SW 31-17-12-W2) and consisted of a nine-year-old, single row shelterbelt planted in the following design: one green ash and one choke cherry. Treatment plots at this site consisted of a single choke cherry plant per plot containing at least one prairie tent caterpillar nest. All plants were at a 0.75 m spacing within the row. Both trials were set up in a randomized complete block design with five replications. Due to the young age of these plants and the small size of the treatment plots, these plants did not produce sufficient fruit for residue analysis. To obtain fruit for residue analysis, an established choke cherry shelterbelt located on the Shelterbelt Centre (SW 11-18-13 W2) was treated at the same rate and on the same day as the other trials with DECIS, MATADOR, SEVIN and a water check. These four treatments were replicated four times in a randomized complete block design. Treatment plots were eight metres long with two metre buffer between plots.

Treatments were applied on May 17, 1998 with a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m^2 of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the shelterbelt. At the time of application the plants were fully leafed out, racemes were fully extended and the flowers were in the early white tip stage. The majority of the choke cherry flowered from May 22 to May 26.

Plant phytotoxicity assessments were made on May 25, 1998. Assessment of PTC larval populations were made on May 25 which was eight days after treatment (DAT) by removing all PTC tents from each treatment plot and counting the number of live larvae per tent. Larvae per tent values were subjected to a square root (x + 1) transformation followed by a two-way analysis of variance. Means were separated using the Duncan's Multiple Range test. Fruit for residue analysis was collected from the established shelterbelt from August 25 to 28 (100 to 103 DAT).

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS, DIPEL, MATADOR or SEVIN. There was no significant difference in the number of PTC tents per plot at either site, indicating a uniform PTC population prior to treatment (Table 1). At Alspach's, DECIS, MATADOR and SEVIN significantly reduced the number of PTC larvae per tent when compared to the water check, whereas DIPEL did not significantly reduce the PTC population compared to the water check. At Bugiera's, all insecticide treatments significantly reduced the number of PTC larvae per tent when compared to the water check. DECIS, MATADOR and SEVIN eliminated PTC populations at both sites eight DAT.

CONCLUSIONS: DECIS, MATADOR or SEVIN applied as a foliar spray to choke cherry prior to flowering and when damage by PTC was first noticed effectively controlled PTC populations. Control with DIPEL was variable. Higher rates of DIPEL and should be tested.

Table 1. Number of prairie tent caterpillar larvae per tent recorded on choke cherry eight days after treatment with insecticide at two sites in Saskatchewan in 1998.

	Rate of product		Alspach farm		Bugiera farm	
Treatment	/ha	/1000L	Tents/ plot	Larvae/ tent[1]	Tents/ plot	Larvae/ tent[1]
DECIS 5EC	0.200 L	0.092 L	1.0 a[2]	0.0 b	1.2 a	0.0 b
DIPEL WP	1.250 kg	0.575 kg	1.0 a	21.6 ab	1.2 a	8.9 b
MATADOR 120 EC	0.125 L	0.058 L	1.2 a	0.0 b	1.0 a	0.0 b
SEVIN XLR PLUS	2.300 L	1.058 L	1.0 a	0.0 b	1.0 a	0.0 b
Water check	-	-	1.2 a	44.9 a	1.4 a	55.7 a

[1] Larvae per tent values were subjected to a square root (x+1) transformation prior to analysis.

[2] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 31 SECTION A: INSECTS OF BERRY CROPS
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana melanocarpa* var. (A. Nels.) Sarg.
PEST: Fruittree leafoller, *Archips argyrospila* (Walker).

NAME AND AGENCY:
NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A.Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284; **Fax:** (306) 695-2568; **E-mail:** neillb@em.agr.ca

TITLE: EVALUATION OF PRODUCTS FOR CONTROL OF FRUITTREE LEAFROLLER ON CHOKE CHERRY IN SASKATCHEWAN, IN 1998.

MATERIALS: DECIS 5 EC (deltamethrin 5% EC), MATADOR 120 EC (cyhalothrin-lambda 12% EC) and SEVIN XLR PLUS (carbaryl 48% LS).

METHODS: The fruittree leafroller (FTLR) is a common defoliator of choke cherry on the Canadian prairies. Although the FTLR does not feed directly on the fruit of choke cherry, infestations may cause severe defoliation resulting in reduced plant vigour. Three insecticides and a water check were evaluated for control of the FTLR. The trial was conducted on a ten-year-old, single row choke cherry shelterbelt near Cabri, Saskatchewan (12-20-20-W3). The four treatments were replicated five times in a randomized complete block design. All plants were at a 0.75 m spacing within the row. Treatment plots were eight metres long with a two metre buffer between plots.

Treatments were applied on May 28, 1998 using a portable high pressure sprayer at 480 kPa and at a rate of 22 L of solution per 100 m^2 of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the shelterbelt. At the time of application the plants were fully leafed out, flowering was complete and fruit development had been initiated. The majority of the choke cherry flowered from May 15 to May 19, 1998.

Plant phytotoxicity assessments were taken on June 2, 1998. Assessment of FTLR larval populations were conducted on May 29, (12 hours after treatment) and June 2 (five days after treatment) by randomly removing ten small branches displaying leafroller damage (several leaves folded and tied together with webbing) from each treatment plot. The leaves were then unfolded and the number of live FTLR larvae per ten branches were recorded. Fruit was collected to determine if insecticide applications affected fruit set. One hundred racemes were collected from each plot (50 from each side) and the number of healthy berries per raceme recorded. Assessments were conducted on August 13 and 14, 1998 (77 and 78 days after treatment). A two-way ANOVA was conducted with means separated by the Duncan's Multiple Range Test. Fruit was collected from each plot for insecticide residue analysis.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS, MATADOR or SEVIN. All insecticide treatments significantly reduced the number of FTLR larvae per plot within 12 hours of application compared to the water check (Table 1). By five days after treatment, FTLR populations were eliminated within the DECIS, MATADOR and SEVIN plots. Fruit set was not adversely affected by the application of insecticide.

CONCLUSIONS: DECIS, MATADOR or SEVIN applied as a foliar spray to choke cherry when damage by FTLR was first noticed did effectively control FTLR populations.

Table 1. Evaluation of three products for control of fruittree leafroller on choke cherry near Cabri, Saskatchewan, in 1998.

Treatments	Rate of product		Fruittree leafroller / plot		Healthy berries/raceme
	L/ha	L/1000L	29 May	2 Jun	
DECIS 5EC	0.2	0.092	2.0 b[1]	0.0 b	6.67 a
MATADOR 120EC	0.125	0.058	3.0 b	0.0 b	6.19 a
SEVIN XLR PLUS	2.3	1.058	2.4 b	0.0 b	5.79 a
Water check	-	-	9.2 a	5.2 a	6.50 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 32 SECTION A: INSECTS OF BERRY CROPS
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana melanocarpa* var. (A. Nels.) Sarg.
PEST: Various insects

NAME AND AGENCY:

NEILL G B, REYNARD D A and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A., Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-2284 Fax: (306) 695-2568 E-mail: neillb@em.agr.ca

TITLE: EVALUATION OF TWO PRODUCTS APPLIED THREE TIMES DURING THE GROWING SEASON FOR CONTROL OF VARIOUS INSECTS FEEDING ON CHOKE CHERRY IN SASKATCHEWAN, IN 1998.

MATERIALS: DECIS 5EC (deltamethrin 5% EC) and SEVIN XLR PLUS (carbaryl 48% LS).

METHODS: There are numerous insects that feed on the fruit and foliage of choke cherry that have the potential to cause a significant loss in fruit production. DECIS, SEVIN and a water check were applied three times during the growing season to determine if an insecticide would control the various insect pests of choke cherry and increase fruit production. The trial was conducted at the PFRA Shelterbelt Centre (SW 11-18-13-W2) near Indian Head, Saskatchewan. The three treatments were replicated six times in a randomized complete block design. Replications one to three were set up on 21 year-old, single-row choke cherry shelterbelt, and replications four to six were set up on a 33 year-old, single-row choke cherry shelterbelt. Treatment plots were 7.5 metres long with a 2.5 metre buffer between plots.

Treatments were applied using a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m^2 of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the shelterbelt. On the first application date, April 28, 1998, choke cherry were in the early leaf development stage with racemes compact. The second application date, May 12, 1998, choke cherry were fully leafed out and racemes were beginning to elongate. On the third application date, May 31,1998, choke cherry were fully leafed out and flowering was complete. The majority of the choke cherry flowered from May 22 to May 26, 1998.

Plant phytotoxicity assessments were taken on July 3, 1998. Assessment of choke cherry midge populations and fruit set was conducted on July 3 and July 7, 1998 (33 and 37 DAT), by collecting 80 racemes per plot (40 from each side) and recording the number of midge infested berries and the number of healthy berries per raceme. The impact of the treatments on fruit production was assessed by collecting 100 racemes from each plot and recording the number of healthy berries per raceme. These assessments were conducted on August 24 and 25, 1998 (85 and 86 DAT). A two-way ANOVA was conducted with means separated by the Duncan's Multiple Range Test. Fruit was collected from each plot for insecticide residue analysis.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS or SEVIN. Insecticide treatments did not have a significant impact on choke cherry midge populations (Table 1). On the July 3 assessment date, DECIS produced significantly more healthy fruit per raceme compared to

SEVIN, but there was no significant difference between DECIS and the water check. On the August 24 assessment date, there was no significant difference between treatments in the number of healthy berries. Plant variability in fruit set may have masked treatment differences.

CONCLUSIONS: Three applications of insecticide during the growing season did not significantly reduced the incidence of choke cherry midge galls nor was fruit production significantly increased. Tests should be conducted on choke cherry clones to reduce fruit set variability.

Table 1. Evaluation of two products applied three times during the growing season for control of choke cherry midge and other insect pests of choke cherry at Indian Head, Saskatchewan in 1998.

	Rate of product		Midge galls / plot	Healthy berries / raceme	
Treatment	L/ha	L/1000 L	July 3	July 3	Aug 24
DECIS 5EC	0.2	0.092	20.3 a[1]	9.14 a	6.90 a
SEVIN XLR PLUS	2.3	1.058	25.2 a	5.79 b	4.83 a
Water check	-	-	23.5 a	7.23 ab	4.63 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 33 **SECTION A: INSECTS OF BERRY CROPS**
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
PEST: Fall Webworm, *Hyphantria cunea* (Drury).

NAME AND AGENCY:
REYNARD D A, NEILL G B and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-5133 Fax: (306) 695-2568 E-mail: reynardd@em.agr.ca

TITLE: EVALUATION OF *BACILLUS THURINGIENSIS* FOR CONTROL OF FALL WEBWORM ON CHOKE CHERRY IN SASKATCHEWAN, IN 1999.

MATERIALS: DIPEL 2XDF (*Bacillus thuringiensis* var. *kurstaki*).

METHODS: The fall webworm is a common tent-forming defoliator of choke cherry on the Canadian prairies. Although the fall webworm does not feed directly on the fruit of choke cherry, infestations may cause severe defoliation of fruit-bearing plants. Three rates of DIPEL 2XDF and a water check were evaluated for control of this insect. The trial was conducted on a five-year old open pollinated choke cherry planting located in the Indian Head Rural Community Forest (SE 24-18-13-W2) near Indian Head, Saskatchewan. The four treatments were replicated six times in a randomized complete block design. All plants were at a one metre spacing within the row. Treatment plots consisted of a single choke cherry plant containing at least one ugly nest caterpillar tent.

Treatments were applied on July 28, 1999 with a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m^2 of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the row. At the time of application the fruit was green and well developed.

Assessment of plant phytotoxicity and fall webworm larval populations was conducted on August 9, 12 days after treatment. Assessment of larval populations was conducted by removing all fall webworm tents from each treatment plot and counting the number of live larvae per tent. Analysis of variance (ANOVA) was conducted using General Linear Model with the means separated by the Duncan's Multiple Range Test.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with the various rates of DIPEL 2XDF. There was no significant difference in the number of fall webworm tents per plot, indicating a uniform pretreatment population of fall webworm (Table 1). All three rates of DIPEL 2XDF significantly reduced the number of fall webworm larvae per plot within 12 days of application compared to the water check.

CONCLUSIONS: All three rates of DIPEL 2XDF applied as a foliar spray to choke cherry when damage by fall webworm was first noticed effectively controlled fall webworm populations within 12 days of application. Since all rates of DIPEL 2XDF tested provided effective control, lower rates of DIPEL 2XDF should be tested.

Table 1. Number of fall webworm larvae per tent recorded on choke cherry 12 days after treatment with three rates of DIPEL 2XDF in Saskatchewan in 1999.

Treatment	Rate of product Kg / ha	Rate of product Kg / 1000 L	Tents / plot	Larvae / tent
DIPEL 2XDF	0.63	0.288	1.20 a[1]	0.4 b
DIPEL 2XDF	1.18	0.54	1.67 a	1.2 b
DIPEL 2XDF	1.6	0.792	1.17 a	0.3 b
Water check	-	-	1.00 a	206.7 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 34 SECTION A: INSECTS OF BERRY CROPS
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana melanocarpa* var. (A. Nels.) Sarg.
PEST: Fruittree leafoller, *Archips argyrospila* (Walker).

NAME AND AGENCY:
REYNARD D A, NEILL G B and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A.Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-5133 Fax: (306) 695-2568 E-mail: reynardd@em.agr.ca

TITLE: EVALUATION OF PRODUCTS FOR CONTROL OF FRUITTREE LEAFROLLER ON CHOKE CHERRY IN SASKATCHEWAN, IN 1999.

MATERIALS: DECIS 5 EC (deltamethrin 5% EC), MATADOR 120 EC (cyhalothrin-lambda 12% EC) and SEVIN XLR PLUS (carbaryl 48% LS).

METHODS: The fruittree leafroller (FTLR) is a common defoliator of choke cherry on the Canadian prairies. Although the FTLR does not feed directly on the fruit of choke cherry, infestations may cause severe defoliation resulting in reduced plant vigour. Three insecticides and a water check were evaluated for control of the FTLR. The trial was conducted on a 11-year-old, single row choke cherry shelterbelt near Cabri, Saskatchewan (12-20-20-W3). The four treatments were replicated five times in a randomized complete block design. All plants were at a 0.75 m spacing within the row. Treatment plots were ten metres long with a two metre buffer between plots.

Treatments were applied on June 7, 1999 using a portable high pressure sprayer at 480 kPa and at a rate of 22 L of solution per 100 m² of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the shelterbelt. At the time of application the plants were fully leafed out, flowering was complete and fruit development had been initiated. The majority of the choke cherry flowered from May 29 to June 2, 1999.

Assessment of plant phytotoxicity and FTLR larval populations were conducted on June 10, three days after treatment. Assessment of larval populations were conducted by randomly removing 15 small branches displaying leafroller damage (several leaves folded and tied together with webbing) from each treatment plot. The leaves were then unfolded and the number of live FTLR larvae per 15 branches were recorded. Fruit was collected to determine if insecticide applications affected fruit set. One hundred racemes were collected from each plot (50 from each side) and the number of healthy berries per raceme recorded. Assessments were conducted on August 24 and 25, 1999 (78 and 79 days after treatment). A two-way ANOVA was conducted with means separated by the Duncan's Multiple Range Test. Fruit was collected from each plot for insecticide residue analysis.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS, MATADOR or SEVIN. All insecticide treatments significantly reduced the number of FTLR larvae per plot within three days of application compared to the water check (Table 1). Fruit set was not adversely affected by the application of insecticide.

CONCLUSIONS: DECIS, MATADOR or SEVIN applied as a foliar spray to choke cherry when damage by FTLR was first noticed did effectively control FTLR populations.

Table 1. Evaluation of three products for control of fruittree leafroller on choke cherry near Cabri, Saskatchewan, in 1999.

Treatments	Rate of product		Fruittree leafroller / plot	Healthy berries/raceme
	L/ha	L/1000L		
DECIS 5EC	0.2	0.092	0.8 b[1]	5.61 a
MATADOR 120EC	0.125	0.058	1.4 b	4.93 a
SEVIN XLR PLUS	2.3	1.058	1.2 b	6.52 a
Water check	-	-	11.0 a	6.14 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 35 SECTION A: INSECTS OF BERRY CROPS
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
PEST: Choke cherry midge, *Contarinia virginianae* Felt.

NAME AND AGENCY:
REYNARD D A, NEILL G B and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A., Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-5133 Fax: (306) 695-2568 E-mail: reynardd@em.agr.ca

TITLE: EVALUATION OF PRODUCTS FOR CONTROL OF CHOKE CHERRY MIDGE ON CHOKE CHERRY AT TWO SITES IN SASKATCHEWAN, IN 1999.

MATERIALS: DECIS 5 EC (deltamethrin 5% EC), ORTHENE T&O (acephate 75% SP) and SPINOSAD 480 SC (spinoyns, *Saccharopolyspora spinosa*).

METHODS: Choke cherry fruit infested by the choke cherry midge (CCM) appears as enlarged, pear-shaped galls. Damage by the midge results in unusable fruit and non-viable seed. This trial was conducted to determine if an insecticide applied prior to flowering would control CCM and increase fruit production. Three insecticides and a water applied control were evaluated for control of the CCM at two sites. The trials were conducted on a 14-year-old, single row choke cherry shelterbelt located on the PFRA Shelterbelt Centre, Indian Head, Saskatchewan (SW 11-18-13-W2) and on a 11-year-old, single row choke cherry shelterbelt located on the Les Williams farm (NW 30-13-8-W2) near Glenavon, Saskatchewan. At the Indian Head site, treatments plots were ten metres long with a 2.5 metre buffer between plots. At the Glenavon site, treatments plots were 7.5 metres long with a two metre buffer between plots. All plants were spaced 0.75 metres apart within the row. At both sites, the four treatments were replicated five times in a randomized complete block design.

Treatments were applied on May 25, 1999 at the Indian Head site and on May 26, 1999 at the Glenavon site. Treatments were applied using a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m² of plant surface area. Treatments were applied to both sides of the shelterbelt until the foliage was wet but not dripping. At the time of application, the plants were fully leafed out and less than 1% flowering initiated. The majority of the choke cherry flowered from May 29 to June 2, 1999.

Assessment of CCM populations were conducted on June 17 at the Indian Head site which was 23 days after treatment (DAT) and on June 28 at the Glenavon site (33 DAT), by randomly collecting 80 racemes per plot (40 from each side) and recording the number of midge infested berries and the number of healthy berries per raceme. Plant phytotoxicity assessments were taken on June17 at the Indian Head site and on June 28 at the Glenavon site.

Mature fruit was collected to determine if insecticide application had an impact on fruit set. The assessment was conducted by collecting 100 racemes from each plot (50 from each side) and recording the number of healthy berries per raceme. These assessments were conducted on August 30 at the Indian Head site (97 DAT) and on August 31 at the Glenavon site (97 DAT). Midge infested berries values were subjected to a log (x + 1) transformation followed by a two-way analysis of variance. Means were then separated using the Duncan's Multiple Range Test. Fruit was collected from each plot for insecticide residue analysis.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with DECIS, ORTHENE or SPINOSAD. DECIS significantly reduce the number of CCM infested berries per plot compared to all other treatments at the Glenavon site (Table 1). There was no significant difference in the number of CCM infested berries per plot between ORTHENE, SPINOSAD and the water check at the Glenavon site. Insecticide treatments did not have a significant impact on the number of CCM infested berries per plot at the Indian Head site. Insecticide application did not adversely affect the number of healthy fruit produced per raceme at either site on either assessment date.

CONCLUSIONS: The incidence of CCM infested berries per plot was significantly reduced with the application of DECIS compared to all other treatment at the Glenavon site. Although DECIS reduced the number of CCM infested berries per plot at the Indian Head site, it was not statistically significant. The application of insecticides did not significantly increase fruit production. Variability of fruit set between plants may have masked treatment differences.

Table 1. Evaluation of products for control of choke cherry midge at two sites, Saskatchewan in 1999.

	Rate of product		Midge infested berries / plot[1]		Healthy berries/ raceme Glenavon		Healthy berries/ raceme Indian Head	
Treatment	/ha	/1000 L	Glen.	I.H.	Jun. 28	Aug. 26	Jun.7	Aug. 30
DECIS 5EC	0.20 L	0.092 L	5.8 b[2]	5.2 a	4.0 a	3.4 a	10.1 a	3.3 a
ORTHENE T&O	1.87 kg	0.850 kg	33.4 a	8.2 a	3.4 a	2.6 a	6.7 a	2.6 a
SPINOSAD 480 SC	0.13 L	0.059 L	36.2 a	18.2 a	2.9 a	2.5 a	6.4 a	2.9 a
Water check	-	-	57.2 a	18.2 a	2.7 a	2.8 a	7.2 a	2.2 a

[1] Midge infested berries values were subjected to a log (x + 1) transformation prior to analysis.

[2] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 36 SECTION A: INSECTS OF BERRY CROPS
STUDY DATABASE: 87000180

CROP: Choke cherry, *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
PEST: Ugly nest caterpillar, *Archips cerasivorana* (Fitch).

NAME AND AGENCY:
REYNARD D A, NEILL G B and MUSQUA D R
Agriculture and Agri-Food Canada, P.F.R.A Shelterbelt Centre, Indian Head, Saskatchewan S0G 2K0
Tel: (306) 695-5133 Fax: (306) 695-2568 E-mail: reynardd@em.agr.ca

TITLE: EVALUATION OF *BACILLUS THURINGIENSIS* FOR CONTROL OF UGLY NEST CATERPILLAR ON CHOKE CHERRY IN SASKATCHEWAN, IN 1999.

MATERIALS: DIPEL 2XDF (*Bacillus thuringiensis* var. *kurstaki*).

METHODS: The ugly nest caterpillar (UNC) is a common tent-forming defoliator of choke cherry on the Canadian prairies. Although the UNC does not feed directly on the fruit of choke cherry, infestations may cause reduced vigour of fruit-bearing plants. Three rates of DIPEL 2XDF and a water check were evaluated for control of this insect. The trial was conducted on a three-year old open pollinated choke cherry regional test planting located on the Agriculture and Agri-Food Canada Research Farm (SW 19-18-12-W2) near Indian Head, Saskatchewan. The four treatments were replicated eight times in a randomized complete block design. All plants were at a one metre spacing within the row. Treatment plots consisted of a single choke cherry plant containing at least one ugly nest caterpillar tent.

Treatments were applied on June 18, 1999 with a portable high pressure sprayer at 480 kPa at a rate of 22 L of solution per 100 m^2 of plant surface area. Plants were sprayed until the foliage was wet but not dripping. Treatments were applied to both sides of the row. At the time of application the plants were fully leafed, flowering was complete and fruit development had been initiated. The majority of the choke cherry flowered May 29 to June 2, 1999.

Assessment of plant phytotoxicity and UNC larval populations was conducted on June 30, 12 days after treatment. Assessment of larval populations was conducted by removing all UNC tents from each treatment plot and counting the number of live larvae per tent. A two-way ANOVA was conducted with the means separated by the Duncan's Multiple Range Test.

RESULTS: No phytotoxic damage was noted on choke cherry plants treated with the various rates of DIPEL 2XDF. There was no significant difference in the number of UNC tents per plot, indicating a uniform pretreatment population of UNC (Table 1). All three rates of DIPEL 2XDF significantly reduced the number of UNC larvae per plot within 12 days of application compared to the water check..

CONCLUSIONS: All three rates of DIPEL 2XDF applied as a foliar spray to choke cherry after flowering and when damage by UNC was first noticed effectively controlled UNC populations within 12 days of application. Since all rates of DIPEL 2XDF provided effective control, lower rates should be tested.

Table 1. Number of ugly nest caterpillar larvae per tent recorded on choke cherry 12 days after treatment with three rates of DIPEL 2XDF in Saskatchewan in 1999.

Treatment	Rate of product		Tents / plot	Larvae / tent
	Kg / ha	Kg / 1000 L		
DIPEL 2XDF	0.63	0.288	1.25 a[1]	7.1 b
DIPEL 2XDF	1.18	0.54	1.13 a	11.4 b
DIPEL 2XDF	1.6	0.792	1.50 a	4.9 b
Water check	-	-	1.50 a	58.0 a

[1] Means in the same column followed by the same letter are not significantly different at the 5% level according to the Duncan's Multiple Range Test.

1999 PMR REPORT # 37 SECTION A: INSECT PESTS OF FRUIT

CROP: Sweet Cherries
PEST: Western Cherry Fruit Fly, *Rhagoletis indifferens* Curran

NAME AND AGENCY:
PHILIP HG and LASHUK CL
BC Ministry of Agriculture and Food, 200-1690 Powick Rd, Kelowna, BC V1X 7G5
Tel: (250) 861-7211 Fax: (250) 861-7490 E-mail: Hugh.Philip@gems8.gov.bc.ca

TITLE: EFFICACY OF SPINOSAD AND ADMIRE AGAINST WESTERN CHERRY FRUIT FLY ON SWEET CHERRY

MATERIALS: SPINOSAD (480 g AI/L), ADMIRE 240 F (imidacloprid), CYGON 480 EC (dimethoate).

METHODS: The trial was conducted at the Pacific Agriculture and Agri-Food Research Centre, Summerland, BC in a 40 year old sweet cherry block. Treatments were replicated three times and assigned to single tree plots, and arranged according to a randomized complete block design. A single yellow sticky fly card (15cm by 30cm) was placed in each test block to detect first emergence of fruit fly adults and was checked weekly to monitor adult activity and abundance throughout the trial period. Treatments were applied within 6 days of first fruit fly capture (17 June). The candidate products were applied to the point of run-off (approximately 10 L of spray mix per tree at a pressure of 900 kPa) using a custom made gas powered handgun sprayer equipped with a Viton nozzle. Two treatment regimes were followed for the candidate products. SPINOSAD 480 EC was applied at two rates, 1.9g and 3.8g AI/100L and applied once (22 June) or twice (22 June and 8 July). ADMIRE 240F was applied at two rates, 1.0g and 2.0g AI/100L and applied once (22 June) or twice (22 June and 8 July). CYGON 480 EC, the standard treatment, was sprayed once on 22 June at a rate of 24g AI/100L (the locally recommended dilute spray rate). The check trees were sprayed with water. At 7, 14, 22 days post-treatment and harvest (29 June, 6 July, 22 July and 21 July, respectively) 50 cherries from the middle of each replicate were collected and examined in the laboratory for the presence of western cherry fruit fly larvae. The fruit was crushed with a potato masher and a brown sugar solution (680 g/L) was added to the fruit pulp. The fruit slurry was agitated then allowed to settle to the let any larvae float to the surface. The larvae were removed from the fruit slurry and examined under an illuminated 1.5X magnifier and the number of larvae per sample was recorded. The data was converted to percent fruit infested (assuming one larva per fruit) and subjected to ANOVA ($p=0.05$).

RESULTS: Data are presented in tables 1 (number of live larvae recovered from fruit samples) and table 2 (weekly captures of adult fruit flies). No phytotoxic effects were observed in any of the treated plots. There was no significant difference ($P>0.05$) between the treatments in the percentage of fruit infested on any the sample dates. The number of larvae recovered from fruit treated with CYGON and the double application of the high rate of ADMIRE was 74% and 84%, respectively, less than the number of larvae recovered from the check fruit.

CONCLUSIONS: Neither the standard treatment CYGON nor the candidates SPINOSAD and ADMIRE fully protected sweet cherry from infestation by the western cherry fruit fly at the rates tested in this field trial. This may have been a result of the intense adult fly pressure in the cherry block.

Table 1. Number of live western cherry fruit fly larvae (total of three replicates/treatment rate).

Treatment	Total g AI/ha	Jun 29	Jul 6	Jul 14	Jul 21	Total
Check	0	0	45	31	4	80
CYGON	854.4	0	5	15	1	21
SPINOSAD (1.9g X 1)	45.0	3	24	35	9	71
SPINOSAD (1.9g X 2)	157.7	0	14	13	7	34
SPINOSAD (3.9g X 1)	111.1	0	19	34	4	57
SPINOSAD (3.8g X 2)	312.7	1	22	25	10	58
ADMIRE (1g X 1)	29.8	2	17	12	1	32
ADMIRE (1g X 2)	89.6	0	13	9	8	30
ADMIRE (2g X 1)	59.5	0	9	19	2	30
ADMIRE (2g X 2)	179.1	0	5	7	1	13

Table 2. Weekly captures of adult western cherry fruit fly.

Date	Trap 1[a]	Trap 2[b]	Trap 3[c]	Total	Mean
21 May	0	0	0	0	0
28 May	0	0	0	0	0
4 June	0	0	0	0	0
11 June	0	0	0	0	0
17 June	5	0	1	6	2.0
25 June	4	5	15	24	8.0
2 July	4	2	2	8	2.7
16 July	1	0	36	37	12.3
23 July	0	0	42	42	14.0
Total	14	7	96	117	39.0

[a] In Rep 1 block

[b] In Rep 2 block

[c] In unsprayed sour cherry block adjacent to Rep 3 block

END OF SECTION A (Pages 1-77; Reports 1-37).

SECTION B: VEGETABLES AND SPECIAL CROPS /LÉGUMES ET CULTURES SPÉCIALES

REPORTS /RAPPORTS # 38 - 52

PAGES: 78 - 135

EDITOR **Dr. Jeff H. Tolman**

Agriculture and Agri-Food Canada
Southern Crop Protection and Food
Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3

Email: tolmanj@em.agr.ca
Tel: (519) 457-1470 Ext. 232
Fax: (519) 457-3997

1999 PMR REPORT # 38 **SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS**
ICAR #: 01030402 —DC#: 72020101

CROP: Broccoli (*Brassica olerace* L. var. *botrytis* subvar. *cymosa* Lam.), cv. Legend
PEST: Cabbage looper (CL) *Trichoplusia ni* (Hubner)
Diamondback moth (DBM) *Plutella xylostella* (L.)
Imported cabbage worm (ICW) *Artogeia rapae* (L.)

NAME AND AGENCY:
SCOTT-DUPREE C D[1], SCHNICK P J[1], REMPEL S J[1] and HARRIS B J[2]
[1] Dept. of Environmental Biology, University of Guelph, Guelph, ON, N1G 2W1.
Tel: (519) 824-4120 X2477 Fax: (519) 837-0442 E-mail: csdupree@evbhort.uoguelph.ca
[2] DowAgrosciences Canada Inc., Calgary, AB, T2E 7P1, Tel: (403) 735-8829

TITLE: EFFICACY OF SUCCESS 480 SC AND DECIS 25 EC AGAINST LEPIDOPTERAN PESTS OF BROCCOLI IN MUCK SOIL, 1999

MATERIALS: SUCCESS 480 SC (spinosad, *Saccharopolyspora spinosa*), DECIS 25 EC (deltamethrin)

METHODS: On May 6, broccoli were planted in the greenhouse at the University of Guelph - Muck Crop Research Station, Bradford, Ontario. Seedlings were transplanted on June 21 into 4 row plots, 12 m in length with a row spacing of 0.9 m. Six treatments were replicated four times in a randomized complete block design. Blocks were separated by 3 m lanes. Foliar insecticide applications were applied using a tractor-mounted, four-row boom sprayer that delivered 500L/ha at 450 kPa using TEEJET flat fan nozzles (#8002). Populations of cabbage looper (CL), imported cabbage worm (ICW) and diamondback moth (DBM) were observed for larval presence, beginning in the second week of July. On July 27, populations of CL, ICW and DBM surpassed an established economic threshold, and the initial treatments were applied. On July 30, 3 days after application (DAA) and August 3, 7 DAA, CL, ICW and DBM larvae were counted on 4 plants per plot using a destructive sampling technique. The larval counts were converted to Cabbage Looper Equivalents (CLE) per head {i.e. CLE= [(1.0 x CL larvae/head)+(0.5 x ICW larvae/head)+(0.2 x DBM larvae/head)]}. A second application was applied 9 days later on August

5. Broccoli were harvested on August 19 and were graded using a marketability scale of 1 to 3 (1=marketable (US fancy), 2=marketable (US Grade1) and 3=unmarketable) based on measurements of head diameter, stem length, and the presence of frass or larvae. Means for treatments were subjected to a one-way analysis of variance, and means were seperated using Duncan's New Multiple Range test ($P \leq 0.05$).

RESULTS: At 3 and 7 DAA, all insecticide treatments provided significant ($P \leq 0.05$) reductions in CL, ICW and DBM populations compared to the control treatment (Table 1). At 3 DAA, while none of the SUCCESS treatments were significantly different from DECIS, the trend was towards improved control by SUCCESS (100 and 200 g AI/ha). A similar trend for SUCCESS (100 and 200 g AI/ha) was evident 7 DAA (Table 1). All broccoli harvested was of marketable quality. The highest harvest ratings were recorded for SUCCESS (200 g AI/ha), SUCCESS (100 g AI/ha) and DECIS with no significant differences among these three treatments.

CONCLUSIONS: The results of this study indicate that SUCCESS (200 g AI/ha) and SUCCESS (100 g AI/ha) provide the best control of CL, ICW and DBM on broccoli grown in muck soil of all the SUCCESS treaments. Furthermore, their efficacy is comparable to the industry standard DECIS.

Table 1. Effects of SUCCESS 480 SC and Decis 25 EC on Cabbage Looper Equivalents (CLE) and harvest ratings for broccoli grown in muck soil at the University of Guelph - Muck Crop Research Station, 1999.

Treatment	Rate (g AI/ha)	1 DBA[1] CLE/head	3 DAA[3] CLE/head	7 DAA CLE/head	Average Harvest rating/head
UNTREATED	-	0.22 b[2]	3.47 a	3.34 a	1.5 ab
SUCCESS	25	0.64 a	0.87 b	1.85 b	2.18 a
SUCCESS	50	0.44 ab	0.54 b	1.19 bc	1.83 ab
SUCCESS	100	0.31 ab	0.29 b	0.56 c	1.25 b
SUCCESS	200	0.46 ab	0.16 b	0.31 c	1.25 b
DECIS	50	0.36 ab	0.49 b	0.97 bc	1.25 b

[1] DBA = days before application (July 26)

[2] Treatment means in the same column followed by the same letter are not significantly different (P• 0.05, Duncan's New MRT).

[3] DAA = days after application (3 DAA= July 30; 7 DAA= August 3)

1999 PMR REPORT # 39 SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS
ICAR #: 01030402 DC#: 72020101

CROP:	Broccoli (*Brassica olerace* L. var. *botrytis* subvar. *cymosa* Lam.), cv. Legend
PEST:	Cabbage looper (CL) *Trichoplusia ni* (Hubner) Imported cabbage worm (ICW) *Artogeia rapae* (L.) Diamondback moth (DBM) *Plutella xylostella* (L.).

NAME AND AGENCY:
SCOTT-DUPREE C D[1], SCHNICK P J[1], REMPEL S J[1] and HARRIS B J[2]
[1] Dept. of Environmental Biology, University of Guelph, Guelph, ON, N1G 2W1.
Tel: (519) 824-4120 X2477 Fax: (519) 837-0442 E-mail: csdupree@evbhort.uoguelph.ca
[2] DowAgrosciences Canada Inc., Calgary, AB, T2E 7P1, Tel: (403) 735-8829

TITLE: EFFICACY OF SUCCESS 480 SC AND DECIS 25 EC AGAINST LEPIDOPTERAN PESTS OF BROCCOLI IN SANDY SOIL, 1999

MATERIALS: SUCCESS 480 SC (spinosad, *Saccharopolyspora spinosa*), DECIS 25EC (deltamethrin)

METHODS: On May 6, broccoli were planted in a seedbed at the University of Guelph - Cambridge Research Station, Cambridge, Ontario. Seedlings were transplanted on June 17 into 4 row plots, 12 m in length with a row spacing of 0.9 m. Six treatments were replicated four times in a randomized complete block design. Blocks were separated by 3 m spray lanes. Foliar insecticide applications were applied using a tractor-mounted, four-row boom sprayer that delivered 750L/ha at 450 kPa using TEEJET flat fan nozzles (#8002). Populations of cabbage looper (CL), imported cabbage worm (ICW) and diamondback moth (DBM) were observed for larval presence, beginning in the second week of July. On July 29, populations of CL, ICW and DBM surpassed an established economic threshold. and the initial spray treatments were applied. On August 5, 7 days after application (DAA), CL, ICW and DBM larvae were counted ON 4 plants per plot using a destructive sampling technique. The larval counts were converted to Cabbage Looper Equivalents (CLE) per head {i.e. CLE= [(1.0 x CL larvae/head)+(0.5 x ICW larvae/head)+(0.2 x DBM larvae/head)]}. A second application was applied 9 days later on August 6. Broccoli were harvested on August 19 and were graded using a marketability scale of (1 to 3) (1=marketable (US fancy), 2=marketable (US Grade1) and 3=unmarketable) based on measurements of head diameter, stem length, and the presence of frass or larvae. Means for treatments were subjected to a one-way analysis of variance, and means were seperated using Duncan's New Multiple Range test ($P \leq 0.05$).

RESULTS: On August 5, 7 DAA, all insecticide treatments provided significantly ($P=0.05$) improved control of CL, ICW and DBM compared to the control treatment (Table 1). All SUCCESS treatments provided protection against the lepidopteran complex statistically equivalent to that of DECIS. The trend, however, was towards improved control using SUCCESS (200 g AI/ha) and SUCCESS (100 g AI/ha). At harvest, all broccoli treated with an insecticide were marketable, while broccoli from the untreated plots were not. While the most marketable harvest ratings were recorded for broccoli from treatments of SUCCESS (200 g AI/ha) and (100 g AI/ha), these ratings were not significantly different from those of treatments of SUCCESS (50 g AI/ha) or DECIS.

CONCLUSIONS: All insecticide treatments provided significant (P=0.05) reductions of insect populations compared to the control treatment. For the 7 day assessment, treatments of SUCCESS controlled insect populations equivalent to Decis, with the trend of SUCCESS (100 and 200 g ai/ha) providing the best control. At harvest, broccoli from all treatments were marketable, except those from the untreated check plots. The results indicate that SUCCESS (200 g AI/ha) and (100 g AI/ha) are the most effective treatments for control of CL, ICW and DBM on broccoli grown on sandy soil. Both compare to the industry standard, DECIS.

Table 1. Effects of SUCCESS 480 SC and Decis 25 EC on Cabbage Looper Equivalents (CLE) and harvest ratings for broccoli grown in sandy soil at the Cambridge Research Station - University of Guelph, 1999.

Treatment	Rate (g AI/ha)	1 DBA[1] CLE/head	7 DAA[3] CLE/head	Average Harvest rating/head
UNTREATED	-	1.54 bc[2]	15.51 a	3.00 a
SUCCESS	25	1.52 bc	3.32 b	1.88 b
SUCCESS	50	1.08 d	1.31 b	1.38 bc
SUCCESS	100	1.32 cd	0.88 b	1.00 c
SUCCESS	200	2.13 a	0.49 b	1.00 c
DECIS	50	1.62 b	1.04 b	1.25 bc

[1] DBA = days before application (July 28)

[2] Treatment means in the same column followed by the same letter are not significantly different (P• 0.05, Duncan's New MRT).

[3] DAA = days after application (August 5)

1999 PMR REPORT # 40 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS

CROP: Cabbage, cv. Bronco
Rutabaga, cv. Laurentian

PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

NAME AND AGENCY:
HALLETT, Rebecca H.
Department of Environmental Biology
University of Guelph
Guelph, Ontario, N1G 2W1
Tel: (519) 824-4120, ext. 4488 Fax: (519) 837-0442 Email: rhallett@evbhort.uoguelph.ca

TITLE: **SINAPIC ACID AND MONOTERPENE COMBINATIONS AS OVIPOSITION DETERRENTS AGAINST CABBAGE MAGGOT ON CABBAGE AND RUTABAGA, 1999**

MATERIALS: Sinapic acid in ethanol; a plastic flexure strip containing a three-component monoterpene mix (3-carene, limonene and *p*-cymene); a plastic flexure strip containing a six-component monoterpene mix (3-carene, limonene, *p*-cymene, terpinolene, â-phellandrene, and myrcene)

METHODS: Cabbage seedlings cv. Bronco were grown in plug trays and then hand- transplanted at the Muck Research Station (Site 1), near Kettleby, ON, on May 17 in 4 row plots, 5 m in length, with a row spacing of 90 cm and a plant spacing of 45 cm. Plots were separated by a 1.5 m spray lane (N-S) and 1.5 m alley (E-W). Six treatments were replicated 5 times in a randomized complete block design. The same experiment was repeated with rutabaga cv. Laurentian at the Cambridge Research Station, near Cambridge, ON (Site 2) where rutabaga was machine-seeded with a Stanhay precision seeder at a rate of 6 seeds/m on May 3. Part of the field was subsequently tilled leaving plants which were arranged in 4 row plots, 5 m in length, with a row spacing of 90 cm. Plots were separated by a 3 m spray lane (N-S) and 3 m alley (E-W). The rutabaga plants were thinned to a plant spacing of 15 cm one month after seeding. Treatments were applied on June 8 at Site 1 and July 13 at Site 2. Treatment 1 consisted of 0.05% sinapic acid sprayed at a rate of 6.67 g/100 m of row. Five g sinapic acid was dissolved in 200 mL ethanol, 9 L buffer and 2 mL Tween 20. This mixture was applied with a backpack sprayer with a fan nozzle (#8006) at a pressure of 250 kPa. Treatment 2 consisted of placing a 5 cm length of a 3-component monoterpene plastic flexure next to each plant. Treatment 3 consisted of placing a 5 cm length of a 6-component monoterpene plastic flexure next to each plant. Treatment 4 consisted of placing a 5 cm length of a 3-component monoterpene plastic flexure next to each plant plus the sinapic acid mixture from Treatment 1. Treatment 5 consisted of placing a 5 cm length of a 6-component monoterpene plastic flexure next to each plant plus the sinapic acid mixture from Treatment 1. Treatment 6 consisted of non-treated control plots. Treatments 2, 3 and 6 were also treated with the same mixuture from treatment 1, not including the sinapic acid, to expose all plots to the ethanol/buffer/Tween 20 solvent mixture. Oviposition traps (black felt collars), were placed randomly on four plants per plot (middle two rows, two per row) around plant stems and against the soil. Traps were established on June 8 at Site 1 and July 14 at Site 2. Egg counts commenced on June 9 at Site 1 and continued for a total of fourteen consecutive days. Egg counts commenced on July 15 at Site 2 and continued for a total of fourteen consecutive days.

Differences in egg numbers between treatments were determined using analysis of variance and a Scheffe's comparison of means. CM damage on cabbage was determined and rated on a scale of 0 to 4 (0 represents < 10% of root damaged; 1 represents 10-25% of root damaged; 2 represents 26-50% of root damaged; 4 represents > 50% of root damaged). CM damage on rutabaga was determined and rated (King, K.M. and A.R. Forbes. 1954. J. Econ. Entomol. 47: 607-615) on a scale of 0 to 4 (0-clean; 1-light; 2-moderate; 4-severe injury). Differences in ratings between treatments were determined non-parametrically using the Kruskal-Wallis analysis of variance and the Mann-Witney-Wilcoxon comparison of means. Rutabaga was harvested on August 18 and yield (t/ha) was determined.

RESULTS: The results are summarized in Tables 1, 2, 3, and 4.

CONCLUSIONS: The number of CM eggs deposited on ovipositional traps was not significantly different among treatments on cabbage (Kettleby site) or rutabaga (Cambridge site). CM damage on treated cabbage was similar to or greater than damage to plants in control plots. CM damage on rutabaga was significantly reduced on plants treated with a 3-component monoterpene plastic flexure in combination with sinapic acid. CM damage on rutabaga was also significantly reduced on plants treated with a 6-component monoterpene plastic flexure in combination with sinapic acid. Yield of rutabaga was greatest from the 3- and 6-component monoterpene/sinapic acid combination treatments.

Table 1. Mean number of cabbage maggot eggs in oviposition traps on cabbage plants treated with various sinapic acid and monterpene combinations near Kettleby, Ontario, 1999.

	Mean number of eggs at indicated treatment					
Date	Sinapic acid	3-CM[1]	6-CM[2]	3-CM + Sinapic acid	6-CM + Sinapic acid	Control
June 9	0a[3]	0.1 ± 0.2a	0	0	0.1 ± 0.4a	0
Jun 10	0.1 ± 0.4a	0.1 ± 0.4a	0.7 ± 2.1a	0.3 ± 1.1a	0.8 ± 1.7a	0.5 ± 2.0a
Ju 11	0.4 ± 0.8a	0.5 ± 1.8a	0.1 ± 0.2a	0.1 ± 0.2a	0.3 ± 0.8a	0.2 ± 0.4a
Jun 12	0	0	0.1 ± 0.2a	0	0.1 ± 0.4a	0
Jun 13	0	0	0.1 ± 0.4a	0	0.1 ± 0.2a	0
Jun 14	0.1 ± 0.2a	0.4 ± 1.2a	0.5 ± 1.8a	0.1 ± 0.4a	0	0.3 ± 1.1a
Jun 15	0.6 ± 1.7a	0.2 ± 0.5a	0	0.4 ± 1.8a	0.1 ± 0.2a	0.2 ± 0.9a
Jun 16	0	0.1 ± 0.4a	0.5 ± 1.8a	0	0	0.2 ± 0.9a
Jun 17	0.3 ± 1.1a	0	0.1 ± 0.4a	0.1 ± 0.3a	0.2 ± 0.5a	0
Jun 18	0	0.2 ± 0.5a	0.1 ± 0.2a	0.1 ± 0.2a	0	0
Jun 19	0.2 ± 0.6a	0.2 ± 0.9a	0.2 ± 0.7a	0.2 ± 0.5a	0.2 ± 0.7a	0.1 ± 0.4a
Jun 20	0.3 ± 0.8a	0.2 ± 0.7a	0.1 ± 0.2a	0.2 ± 0.4a	0	0.2 ± 0.5a
Jun 21	0.3 ± 0.6a	0.1 ± 0.3a	0.1 ± 0.2a	0	0	0.2 ± 0.5a
Jun 22	0.1 ± 0.2a	0	0.1 ± 0.2a	0.1 ± 0.2a	0.1 ± 0.4a	0

[1] Three-component monoterpene

[2] Six-component monoterpene

[3] Values followed by the same letter, in the same row, are not significantly different at the 5% level of significance; Scheffe's comparison of means.

Table 2. Mean number of cabbage maggot eggs in oviposition traps on rutabaga plants treated with various sinapic acid and monterpene combinations near Cambridge, Ontario, 1999.

	Mean number of eggs at indicated treatment					
Date	Sinapic acid	3-CM[1]	6-CM[2]	3-CM + Sinapic acid	6-CM + Sinapic acid	Control
Jul 15	0a[3]	0.9 ± 1.8a	0.2 ± 0.9a	0.8 ± 1.6a	0.2 ± 0.5a	0.3 ± 0.9a
Jul 16	0.8 ± 1.9a	0.2 ± 0.4a	0	0.2 ± 0.7a	0	1.6 ± 4.7a
Jul 17	0.2 ± 0.5a	0.1 ± 0.4a	0.1 ± 0.2a	0.3 ± 1.8a	0.5 ± 1.8a	0.1 ± 0.3a
Jul 18	1.1 ± 2.3a	2.3 ± 4.5a	0.5 ± 1.0a	1.3 ± 4.0a	0.9 ± 3.3a	1.1 ± 2.7a
Jul 19	0.7 ± 1.1a	0.2 ± 0.4a	0.7 ± 2.9a	1.0 ± 4.2a	2.5 ± 7.5a	0.5 ± 1.0a
Jul 20	0.7 ± 2.5a	0.5 ± 1.8a	1.2 ± 4.5a	1.3 ± 3.4a	0.3 ± 0.9a	1.0 ± 2.7a
Jul 21	1.9 ± 3.6a	0.4 ± 0.9a	0.2 ± 0.5a	4.2 ± 13.2a	3.1 ± 9.5a	2.5 ± 3.7a
Jul 22	0.7 ± 1.3a	1.9 ± 4.7a	1.6 ± 4.4a	1.1 ± 2.3a	0.2 ± 0.7a	1.8 ± 2.3a
Jul 23	0.6 ± 1.1a	0.2 ± 0.7a	0.1 ± 0.2a	0.5 ± 1.1a	0.1 ± 0.2a	1.3 ± 3.0a
Jul 24	0.2 ± 0.5a	1.0 ± 2.7a	1.3 ± 3.3a	1.4 ± 2.5a	0.5 ± 1.1a	0.4 ± 0.8a
Jul 25	0.1 ± 0.2a	0.1 ± 0.3a	0.4 ± 0.9a	0.5 ± 1.0a	0.5 ± 1.4a	0.4 ± 0.9a
Jul 26	1.0 ± 2.3a	0.6 ± 1.1a	1.2 ± 2.2a	0.6 ± 1.1a	0.4 ± 1.1a	0.3 ± 0.9a
Jul 27	0.2 ± 0.5a	0.6 ± 1.1a	0.5 ± 1.6a	0.8 ± 1.8a	0.4 ± 0.8a	1.0 ± 2.4a
Jul 28	0.3 ± 0.7a	0.6 ± 1.0a	0.3 ± 0.7a	0.5 ± 1.2a	0.7 ± 2.9a	0.2 ± 0.5a

[1] Three-component monoterpene

[2] Six-component monoterpene

[3] Values followed by the same letter, in the same row, are not significantly different at the 5% level of significance; Scheffe's comparison of means.

Table 3. Mean cabbage maggot damage index on cabbage plants (Site 1; Kettleby, ON) and on rutabaga plants (Site 2; Cambridge, ON) treated with various sinapic acid and monterpene combinations, 1999.

Treatment	Mean cabbage maggot damage index[1]	
	Cabbage	Rutabaga
Sinapic acid	0.6 ± 0.8ab[2]	0.7 ± 0.5b
3-CM[3]	0.4 ± 0.6a	0.7 ± 0.7b
6-CM[4]	0.7 ± 0.5b	0.7 ± 0.7b
3-CM + Sinapic acid	0.5 ± 0.8ab	0.2 ± 0.4a
6-CM + Sinapic acid	0.4 ± 0.5ab	0.3 ± 0.6a
Control	0.3 ± 0.4a	0.7 ± 0.7b

[1] 0= least, 4 = greatest degree of damage (± one standard deviation)

[2] Values followed by the same letter, in the same column, are not significantly different at the 5% level of significance; Kruskal-Wallis analysis of variance and the Mann-Witney-Wilcoxon comparison of means.

[3] Three-component monoterpene

[4] Six-component monoterpene

Table 4. Mean yield of rutabaga (Site 2; Cambridge, ON) treated with various sinapic acid and monterpene combinations, 1999.

Treatment	Mean yield (t/ha) of rutabaga[1]
Sinapic acid	4.0 ± 1.6a[2]
3-CM[3]	2.7 ± 2.1a
6-CM[4]	3.5 ± 2.7a
3-CM + Sinapic acid	6.9 ± 5.0a
6-CM + Sinapic acid	4.5 ± 2.7a
Control	3.6 ± 1.9a

[1] Diameter greater than 10 cm

[2] Values followed by the same letter, in the same column, are not significantly different at the 5% level of significance; Scheffe's comparison of means.

[3] Three-component monoterpene

[4] Six-component monoterpene

1999 PMR REPORT # 41 **SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS**

CROP: Cabbage, cv. Bronco
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

NAME AND AGENCY:
HALLETT, Rebecca H.
Department of Environmental Biology
University of Guelph
Guelph, Ontario N1G 2W1
Tel: (519) 824-4120, ext. 4488; Fax: (519) 837-0442; Email: rhallett@evbhort.uoguelph.ca

TITLE: RELATIVE EFFICACY OF THREE APPLICATION METHODS USING LORSBAN 4E OR LORSBAN 50W TO CONTROL CABBAGE MAGGOT ON CABBAGE, 1999

MATERIALS: LORSBAN 4 E (chlorpyrifos; 480 g/L), LORSBAN 50 W (chlorpyrifos; 50% w/w)

METHODS: Cabbage seedlings cv. Bronco were grown in plug trays and then hand- transplanted at the Muck Research Station (Site 1), near Kettleby, ON, on May 17, 1999 in 4 row plots, 5 m in length, with a row spacing of 90 cm and a plant spacing of 45 cm. Plots were separated by a 3 m spray lane (N-S) and 1.5 m alley (E-W). Four treatments were replicated 5 times in a randomized complete block design. The same experiment was repeated at a nearby farm (Site 2) where cabbage was hand-transplanted on May 20. The same experiment, but with 10 replications, was repeated at the Cambridge Research Station (Site 3), near Cambridge, ON, where cabbage was machine-planted (Hollandia transplanter) on May 25. Treatment 1 consisted of LORSBAN 4E applied to plug trays three days prior to transplanting at a rate of 3.4 g/L, with 475 mL applied with a watering can to one tray (128 plants). Treatment 2 consisted of LORSBAN 50W applied within an hour after transplanting at a rate of 0.35 g/L, with 200 mL poured around the base of each plant. Treatment 3 consisted of LORSBAN 4E applied 3 days after transplanting with a watering can at a rate of 210 mL/130 L water per 1000 m of row. Treatment 4 consisted of non-treated control plots. At Sites 1 and 2, destructive sampling took place on July 16 and just prior to harvest on August 5. At Site 3, destructive sampling took place on July 15 and just prior to harvest on August 19. CM damage was determined and rated on a scale of 0 to 4 (0 represents < 10% of root damaged; 1 represents 10-25% of root damaged; 2 represents 26-50% of root damaged; 4 represents > 50% of root damaged). Differences in ratings between treatments were determined non-parametrically using the Kruskal-Wallis analysis of variance and the Mann-Witney-Wilcoxon comparison of means.

RESULTS: The results are summarized in Tables 1 and 2.

CONCLUSIONS: All three LORSBAN treatments reduced CM damage relative to non-treated controls. Applying LORSBAN at transplanting and 3 days after transplanting were equally effective and both methods were more effective than applying LORSBAN to plug trays 3 days prior to transplanting. The mean yields between treatments at Site 1 were similar and not significantly different ($P>0.05$). At Sites 2 and 3 the plots treated with LORSBAN 4E applied to the soil 3 days after transplanting had the greatest yields, but were not significantly higher than yields from other treatments ($P>0.05$).

Table 1. Mean cabbage maggot damage index of cabbage treated with LORSBAN 4E or LORSBAN 50W using different application methods, near Kettleby (Sites 1 and 2), and Cambridge (Site 3), Ontario, 1999.

Treatment	Method[2]	Mean damage rating for indicated date[1]	
		Site 1	
LORSBAN 4E	Tray	0.20 ± 0.41a[3]	1.10 ± 0.55a
LORSBAN 50 W	Transplant	0.30 ± 0.47ab	0.80 ± 0.77a
LORSBAN 4E	Drench	0.15 ± 0.37a	1.00 ± 0.97a
Control	---	0.60 ± 0.68bc	1.10 ± 0.55a
		Site 2	
LORSBAN 4E	Tray	0.65 ± 0.59c	1.25 ± 0.97a
LORSBAN 50 W	Transplant	0.15 ± 0.37a	0.65 ± 0.75b
LORSBAN 4E	Drench	0.15 ± 0.37ab	0.95 ± 0.69ab
Control	---	1.25 ± 0.55d	1.40 ± 0.75a
		Site 3	
LORSBAN 4E	Tray	0.25 ± 0.49b	0.03 ± 0.16a
LORSBAN 50 W	Transplant	0.13 ± 0.33ab	0.05 ± 0.22a
LORSBAN 4E	Drench	0.03 ± 0.16a	0
Control	---	0.18 ± 0.38b	0.13 ± 0.46a

[1] 0= least, 4 = greatest degree of damage (± one standard deviation)

[2] Tray =application to plug tray 3 days prior to transplanting; Transplant = application to soil 3 days after transplanting; Drench = application to soil 3 days after transplanting.

[3] Values followed by the same letter, within the same column for each site, are not significantly different at the 5% level of significance; Kruskal-Wallis analysis of variance and the Mann-Witney-Wilcoxon comparison of means.

Table 2. Mean yield of cabbage from plug trays or field plots treated with LORSBAN 4E or LORSBAN 50W using different treatment methods, near Kettleby (Sites 1 and 2) or Cambridge (Site 3), Ontario, 1999.

Treatment	Method[1]	Mean yield (t/ha)		
		Site 1	Site 2	Site 3
LORSBAN 4E	Tray	69.0 ± 4.4a[2]	50.5 ± 7.9a	16.6 ± 2.2a
LORSBAN 50W	Transplant	70.1 ± 7.9a	55.8 ± 6.6a	17.8 ± 2.1a
LORSBAN 4E	Drench	70.7 ± 8.1a	61.5 ± 1.9a	19.1 ± 3.0a
Control	---	71.5 ± 5.9a	50.3 ± 4.9a	17.7 ± 4.0a

[1] Tray =application to plug tray 3 days prior to transplanting; Transplant = application to soil 3 days after transplanting; Drench = application to soil 3 days after transplanting.

[2] Values followed by te same letter, within the same column, are not significantly different at the 5% level of significance; Scheffe's comparison of means.

1999 PMR REPORT # 42 **SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS**
STUDY DATA BASE: 280-1252-9304

CROP: Cabbage, cv. Lennox
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

NAME AND AGENCY:
TOLMAN J H, BARR T R, McANINCH A L , McFADDEN G A
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

and McKEOWN A
University of Guelph, Horticulture Research Institute of Ontario
Box 587, Simcoe, Ontario N3Y 4N5
Tel: (519) 426-7127 ext. 329 Fax: (519) 426-1225 E-mail: AMckeown@hrio.uoguelph.ca

TITLE: EVALUATION OF PLANTING TREATMENTS FOR CONTROL OF DAMAGE BY CABBAGE MAGGOT TO CABBAGE IN MINERAL SOIL, 1999

MATERIALS: CANON 200 SC (fipronil), ACTARA 25 WG (thiamethoxam), LORSBAN 50 WP (chlorpyrifos), SNIPER 50 WP (azinphosmethyl), thiram/carbendazim, iprodione + metalaxyl

METHODS: Commercial film seed coatings, containing fungicides ± insecticide, were applied by BEJOZADEN Ltd. in Warmenhuizen, Holland. Coated seed was single-seeded into PROMIX™ PGX plug-mix media in 200-cell plug-propagation trays at Simcoe, ON, on April 26. Seedlings were grown to the 4-6 leaf stage in the greenhouse at Simcoe. On May 27, 3 hrs prior to planting, tray drench (TD) treatments (Tmts. 4-7, Table 1) were applied at 275 kPa in 3.0 ml/plant using a hand-held, single-nozzled (6506EVS flat fan), CO_2-pressurized, R&D plot sprayer. Plants were immediately flushed with 6.0 ml water/plant to rinse the insecticide from the foliage and down into the planting medium of individual plugs. Seedlings were transplanted into 1-row microplots (2.25 m long x 0.9 m wide), filled with insecticide residue-free mineral soil, on the London Research Farm of the Southern Crop Protection and Food Research Centre. Each row contained 15 transplants. All treatments received 100 ml starter fertilizer (soluble 10-52-10 [N-P-K] at 2.5 g/L) in the planting hole; insecticide for the planting water (PW)(Tmt. 8, Table 1) was added to the starter fertilizer. All treatments were replicated three times in a randomized complete block design. On June 2, 10-15 CM eggs from an insecticide-susceptible, laboratory strain, originally collected near Chatham, ON, were buried 1 cm deep beside each plant. To improve egg hatch and maggot survival, plots were watered after infestation. On June 29, infested plants were carefully dug, roots washed and rated for CM feeding damage (0 - no feeding damage; 1 - small feeding channels on root/stem comprising < 5% surface area; 2 - 6%-25% surface area affected by feeding; 3 - 26%-50% surface area affected by feeding; 4 - 51%-75% surface area affected by feeding; 5 -76%-100% surface area affected by feeding, plant stunted, dying or dead. If feeding extended down into cortex of root, damage rating was increased by 1). Numbers of plants with ratings of 0 and 1, and with ratings of 3, 4 and 5, were summed, percentage of total infested plants calculated and data subjected to arcsin square root transformation prior to statistical analysis by analysis of variance. Significance of differences among treatments means was determined using Student-Neuman-Keul's Multiple Range Test. Untransformed data are presented.

RESULTS/OBSERVATIONS: CM-feeding damage to cabbage roots following insecticide application in seed coating or as planting treatments is shown in Table 1 below. No phytotoxicity was observed following any treatment.

CONCLUSIONS: Application of SNIPER in the planting water provided best protection of cabbage roots; nearly 85% of roots showed less than 5% damage from CM hatching from introduced eggs. TD-application of the lower rate of CANON and the higher rate of ACTARA also significantly increased the % cabbage roots with less than 5% damage. No treatment had a significant impact on the % of severely damaged cabbage roots.

Table 1. Effect of planting treatments on damage to cabbage roots by cabbage maggot, London, ON, 1999.

Tmt. No.	Insecticide Applied	Rate Applied (pdct)	Method[1]	Mean % Roots in Indicated Category	
				Rating 0-1	Rating 3-5
1	CANON 200SC	125.0 ml/unit[2]	SD	66.7 abc[3]	15.6 a
2	CANON 200SC	250.0 ml/unit	SD	66.7 abc	17.8 a
3	LORSBAN 50WP	19.2 g/unit	SD	62.2 abc	6.7 a
4	CANON 200SC	20.0 ml/1,000 plants	TD	80.0 ab	4.4 a
5	CANON 200SC	40.0 ml/1,000 plants	TD	46.7 b	22.2 a
6	ACTARA 25WG	16.0 g/1,000 plants	TD	28.9 c	33.3 a
7	ACTARA 25WG	32.0 g/1,000 plants	TD	77.8 ab	4.4 a
8	SNIPER 50WP	200.0 g/1,000 plants	PW	84.4 a	4.4 a
9	untreated	----	--	31.1 c	35.6 a

[1] Method of Application: SD - seed dressing; TD - tray-drench; PW - planting water.

[2] Each unit comprises 100,000 seeds.

[3] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined by Student-Neuman-Keul's Multiple Range Test.

1999 PMR REPORT # 43 **SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS**
ICAR #: 01030402 DC#: 72020101

CROP: Cauliflower (*Brassica olerace* L. var. *botrytis* subvar. *cultiflora* DC.), cv. White Queen

PEST: Cabbage looper (CL) *Trichoplusia ni* (Hubner)
Imported cabbage worm (ICW) *Artogeia rapae* (L.)
Diamondback moth (DBM) *Plutella xylostella* (L.).

NAME AND AGENCY:

SCOTT-DUPREE C D[1], SCHNICK P J[1], REMPEL S J[1] and HARRIS B J[2]
[1] Dept. of Environmental Biology, University of Guelph, Guelph, ON, N1G 2W1.
Tel: (519) 824-4120 X2477 Fax: (519) 837-0442 E-mail: csdupree@evbhort.uoguelph.ca
[2] DowAgrosciences Canada Inc., Calgary, AB, T2E 7P1, Tel: (403) 735-8829

TITLE: **EFFICACY OF SUCCCESS 480 SC AND DECIS 25 EC AGAINST LEPIDOPTERAN PESTS OF CAULIFLOWER IN MUCK SOIL, 1999**

MATERIALS: SUCCESS 480 SC (spinosad, *Saccharopolyspora spinosa*), DECIS 25 EC (deltamethrin)

METHODS: On May 6, cauliflower were planted in the greenhouse at the University of Guelph Muck Crop Research Station, Bradford, Ontario. Seedlings were transplanted on June 21 into 4 row plots, 12 m in length with a row spacing of 0.9 m. Six treatments were replicated four times in a randomized complete block design. Blocks were separated by 3 m lanes. Foliar insecticide applications were applied using a tractor-mounted, four-row boom sprayer that delivered 500L/ha at 450 kPa using TEEJET flat fan nozzles (#8002). Populations of cabbage looper (CL), imported cabbage worm (ICW) and diamondback moth (DBM) were observed for larval presence, beginning in the second week of July. On July 27, populations of CL, ICW and DBM surpassed an established economic threshold, and the initial spray was applied for all treatments. On July 30, 3 days after application (DAA) and on Aug 3, 7 DAA, CL, ICW and DBM larvae were counted on 4 plants per plot using a destructive sampling technique. The larval counts were converted to Cabbage Looper Equivalents (CLE) per head {i.e. CLE= [(1.0 x CL larvae/head)+(0.5 x ICW larvae/head)+(0.2 x DBM larvae/head)]}. A second application of all spray treatments was applied 9 days later on August 5. Cauliflower were harvested on Sept 10 and were graded using a marketability scale of (1 -to 3) (i.e. 1=marketable (US fancy), 2=marketable (US Grade1) and 3=unmarketable) based on measurements of head diameter, and the presence of frass or larvae. Means for treatments were subjected to a one-way analysis of variance, and means were seperated using Duncan's New Multiple Range test $P \leq 0.05$).

RESULTS: On July 26, 1day before application (DBA), there was no significant difference in the CLE/head for all treatments ($P \leq 0.05$)(Table 1). On July 30, 3 DAA, CL, ICW and DBM populations were significantly lower for SUCCESS (100 and 200 g AI/ha) compared to the untreated control and DECIS. On August 3, 7 DAA, SUCCESS (100 and 200 g AI) again provided significantly more effective control of lepidopteran pests in cauliflower than the other treatments. However, SUCCESS (100 and 200 g AI/ha) were not significantly more effective than DECIS 7 DAA (Table 1). Cauliflower treated with SUCCESS (200 g AI/ha) had the best harvest ratings, although they were not significantly different from cauliflower harvested in the SUCCESS (100 g AI/ha), Success (75 g AI/ha) and DECIS (Table 1).

CONCLUSIONS: All insecticide treatments provided significant (P=0.05) reductions of insect populations compared to the control treatment. For the 3 and 7 day assessments, treatments of SUCCESS (100 and 200 g ai/ha) reduced insect populations the most, providing significantly (p=0.05) higher levels control than Decis at 3 DAA, and equivalent levels of control at 7 DAA. At harvest, cauliflower from all treatments were marketable, except a fraction of those from the untreated plots and the 25 g ai/ha SUCCESS treated plots. The results of this study indicate that SUCCESS 480 SC applied at 100 and 200 g AI/ha appear to provide the best protection against CL, ICW and DBM and the best harvest ratings for cauliflower grown on muck soils.

Table 1. Effects of SUCCESS 480 SC and Decis 25 EC on Cabbage Looper Equivalents (CLE) and harvest ratings for cauliflower grown in muck soil at the Muck Crop Research Station - University of Guelph, 1999.

Treatment	Rate (g AI/ha)	1 DBA[1] CLE/head	3 DAA[3] CLE/head	7 DAA CLE/head	Average Harvest Rating/head
UNTREATED	-	0.71 a[2]	3.45 a	5.16 a	2.09 ab
SUCCESS	25	0.55 a	1.09 b	1.74 b	2.25 a
SUCCESS	50	0.72 a	0.44 bc	1.16 bc	1.75 abc
SUCCESS	100	0.80 a	0.03 c	0.39 c	1.5 bc
SUCCESS	200	0.68 a	0.01 c	0.32 c	1.06 c
DECIS	50	0.64 a	0.82 b	1.14 bc	1.56 abc

[1] DBA = days before application (July 26)

[2] Treatment means in the same column followed by the same letter are not significantly different (P• 0.05, Duncan's New MRT).

[3] DAA = days after application (3 DAA = July 30; 7 DAA= August 3)

1999 PMR REPORT # 44 SECTION B: INSECTS of VEGETABLES and SPECIAL CROPS
ICAR #: 01030402 DC#: 72020101

CROP: Cauliflower (*Brassica olerace* L. var. *botrytis* subvar. *cultiflora* DC.), cv. White Queen

PEST: Cabbage looper (CL) *Trichoplusia ni* (Hubner)
Imported cabbage worm (ICW) *Artogeia rapae* (L.)
Diamondback moth (DBM) *Plutella xylostella* (L.).

NAME AND AGENCY:
SCOTT-DUPREE C D[1], SCHNICK P J[1], REMPEL S J[1] and HARRIS B J[2]
[1] Dept. of Environmental Biology, University of Guelph, Guelph, ON, N1G 2W1.
Tel: (519) 824-4120 X2477 Fax: (519) 837-0442 E-mail: csdupree@evbhort.uoguelph.ca
[2] DowAgrosciences Canada Inc., Calgary, AB, T2E 7P1, Tel: (403) 735-8829

TITLE: EFFICACY OF SUCCESS 480 SC AND DECIS 25 EC AGAINST LEPIDOPTERAN PESTS OF CAULIFLOWER IN SANDY SOIL, 1999

MATERIALS: SUCCESS 480 SC (spinosad, *Saccharopolyspora spinosa*), DECIS 25 EC (deltamethrin)

METHODS: On May 6, cauliflower were planted in a seedbed at the Univ. of Guelph, Cambridge Research Station, Cambridge, Ontario. Seedlings were transplanted on June 22 into 4 row plots, 10 m in length with a row spacing of 0.9 m. Six treatments were replicated four times in a randomized complete block design. Blocks were separated by 3 m spray lanes. Foliar insecticide applications were applied using a tractor-mounted, four-row boom sprayer that delivered 750L/ha at 450 kPa with TEEJET flat fan nozzles (#8002). Populations of cabbage looper (CL), imported cabbage worm (ICW) and diamondback moth (DBM) were observed for larval presence, beginning in the second week of July. On July 29, populations of CL, ICW and DBM surpassed an established economic threshold, and the initial spray was applied. On Aug 5, 7 days after application (DAA), CL, ICW and DBM larvae were counted on 4 plants per plot using a destructive sampling technique. The larval counts were converted to Cabbage Looper Equivalents (CLE) per head {i.e. CLE= [(1.0 x CL larvae/head)+(0.5 x ICW larvae/head)+(0.2 x DBM larvae/head)]}. A second application of treatments was applied 9 days later, on August 6. Means for treatments were subjected to a one-way analysis of variance, and means were seperated using Duncan's New Multiple Range test $P \leq 0.05$). Harvest data is not available for this study.

RESULTS: On August 5, 7 DAA, all SUCCESS and the DECIS treatments had significantly fewer ($P \leq 0.05$) CLE's/head than untreated plots. SUCCESS (200 g AI/ha) provided was significantly better control of the lepidopteran pest complex on cauliflower compared to SUCCESS (25 g AI/ha), but was not significantly more effective than SUCCESS (50 g AI/ha) or SUCCESS (75 g AI/ha). All SUCCESS treatments were comparable to DECIS (Table 1).

CONCLUSIONS: The results of this study indicate that SUCCESS is as effective as DECIS in controlling CL, ICW and DBM in cauliflower grown on sandy soils. SUCCESS (200 g AI/ha) appears to be the most effective of all the SUCCESS treatments.

Table 1: **Effects of Success 480 SC and Decis 25 EC on Cabbage Looper Equivalents (CLE) and harvest ratings for cauliflower grown in sandy soil at the Cambridge Research Station - University of Guelph, 1999.**

Treatment	Rate (g AI/ha)	1 DBA[1] CLE/head	7 DAA[3] CLE/head
UNTREATED	-	1.02 a[2]	13.56 a
SUCCESS	25	0.88 a	1.41 b
SUCCESS	50	0.55 a	0.75 bc
SUCCESS	100	1.07 a	0.81 bc
SUCCESS	200	0.69 a	0.11 c
DECIS	50	1.08 a	0.35 bc

[1] DBA = days before application (July 28)

[2] Treatment means in the same column followed by the same letter are not significantly different (P• 0.05, Duncan's New MRT).

[3] DAA = days after application (August 5)

1999 PMR REPORT # 45 **SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS**
STUDY DATA BASE: 280-1252-9904

CROP: Cucumber, cv. Calypso
Squash, cv. New England Blue Hubbard
Pumpkin cv. Howden
PEST: Striped cucumber beetle (SCB), *Acalymma vittatum* (Fabricius)

NAME AND AGENCY:
MACINTYRE J K, SCOTT-DUPREE C D
Dept. Environmental Biology, U. of Guelph, Guelph, Ontario N1G 2W1
Tel: (519) 824-4120 ext. 2477 Fax: (519) 837-0442 E-mail: csdupree@evbhort.uoguelph.ca

and TOLMAN J H
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: EVALUATION OF FOLIAR AND PLANTING WATER TREATMENTS FOR CONTROL OF STRIPED CUCUMBER BEETLE ATTACKING PUMPKIN, CUCUMBER, AND SQUASH IN MINERAL SOIL, 1999

MATERIALS: ADMIRE 240 F (imidacloprid), RIPCORD 400 EC (cypermethrin), THIODAN 4 EC (endosulfan), SNIPER 50 WP (azinphos-methyl)

METHODS: Treatments for each crop were replicated three times in a randomized complete block design (RCBD). Foliar treatments were applied to both cucumber and pumpkin seedlings. Pumpkin seeds were hand-planted on the London Research Farm (LRF) of the Southern Crop Protection and Food Research Centre (SCPFRC) on July 7 in 2-row plots in mineral soil. Rows were 1 m apart; each row contained 5 hills (2 seeds/hill) separated by 1 m. On July 26, when seedlings had developed 1-4 true leaves, 12 leaves were randomly tagged in each plot. Later on July 26, all treatments (Table 1) were applied at 250 kPa in 550 L/ha using a hand-held, CO_2-pressurized R&D plot sprayer with a 2 m boom fitted with 4, XR11002VS flat fan spray nozzles. On July 27, 1 day after treatment (DAT), and thereafter at regular intervals (Table 1), a total of 2 tagged leaves were harvested from each plot of each treatment and returned to the laboratory for bioassay. On August 6, using a Planet Jr. hand-seeder, 2 rows of cucumber seed (102 m long), separated by 0.75 m, were seeded in mineral soil on the SCPFRC-LRF. Once emergence was complete, 4 m plots, separated by 2 m buffers, were staked down the length of the block. On August 26, when seedlings had developed 1-3 true leaves, 12 leaves were tagged in all plots and foliar treatments (Table 2) applied as described for pumpkin. On August 27, 1 DAT, and thereafter at regular intervals, a total of 2 tagged leaves were harvested from each plot of each treatment and returned to the laboratory for bioassay.

Planting water treatment was applied only to squash. On June 21, two squash seeds were planted into each cell of 32-cell plug-propagation trays in Premier ProMix BX growing medium. On June 29, plugs containing seedlings with 2-3 true leaves were transplanted into single row (6 plugs/row) microplots (2.25

m long x 0.9 m wide), filled with insecticide residue-free mineral soil, on the SCPFRC-LRF. All treatments received 150 ml starter fertilizer (soluble 10-52-10 [N-P-K] at 2.5 g/L) in the planting hole. The desired rate of ADMIRE was added to starter solution for Tmt.1 and 2 (Table 3). Individual plugs were established in planting holes as soon as possible after adding planting water. On July 6, 8 DAT, and thereafter at regular intervals (Table 3), systemic activity of imidacloprid absorbed by growing seedlings was measured in the laboratory using a leaf-bioassay.

In the laboratory, harvested leaves were trimmed to a length of 8 cm. To maintain leaf quality, the butt end of each trimmed leaf was then carefully inserted through the rubber septum of a "rose vial" filled with 3.0 ml of water. The sharp tip of the completed preparation was pushed out through the bottom of a disposable 7.5 x 9.0 cm Styrofoam cup, leaving the treated leaf upright inside the cup. On each collection date a total of 6 bioassays (2 bioassays/plot x 3 plots/tmt.), each containing 1 leaf and 5 field-collected SCB adults, was established for each treatment. Each bioassay was covered with a glass petri dish and transferred to a controlled environment cabinet at 25±1°C, 55% ± 5% RH and 16:8 (L:D) photoperiod. Mortality and leaf damage were recorded after 24, 48 and 72 hours. Leaf damage was rated using a 0-10 scale where 0 represented no feeding damage, 5 represented 50% loss of leaf area, and 10 represented 100% consumption of the leaf. Mortality was calculated using Abbott's correction. Statistical significance of differences among treatments was determined by analysis of variance and Fisher's protected LSD test. Adult-damage reduction was determined by subtracting individual bioassay damage ratings from the average CONTROL damage rating and calculating % reduction. On July 24 (cucumbers) and July 29 (immature squash), vegetable samples were collected from all plots of a separate planting water-experiment and delivered to the laboratory of the Analytical Chemistry Services Group in the London laboratory of the SCPFRC for HPLC-determination of levels of imidacloprid.

RESULTS/OBSERVATIONS: See Tables 1, 2 and 3 below. For the sake of brevity, only results observed after 72 hours are reported. No phytotoxicity was observed following any treatment

RESIDUES: Results of analyses of imidacloprid residues in cucumber and squash are not yet available.

CONCLUSIONS:

Pumpkin - Foliar Treatments (Table 1):

Mortality of SCB introduced onto pumpkin leaves harvested 1 DAT ranged from less than 50% for ADMIRE up to 100% for SNIPER. While almost no feeding damage was observed in bioassays treated with ADMIRE, SNIPER and RIPCORD, an average of 54% of the area of leaves from untreated plants was consumed in the same bioassay. By 4 DAT, damage reduction in treated plants fell to just below 30% for RIPCORD, THIODAN and ADMIRE but remained over 50% for pumpkins treated with SNIPER. By 7 DAT, no treatment effectively reduced SCB-feeding damage.

Cucumber - Foliar Treatments (Table 2):

Mortality of SCB introduced onto cucumber leaves harvested 1 DAT ranged from approximately 13 % in plants treated with THIODAN to over 96% in those treated with SNIPER. In spite of low mortality 1 DAT, feeding damage at that time was reduced by over 90% in plants treated with RIPCORD and ADMIRE. An average of 32% of the area of leaves from untreated plants was consumed in the same bioassay. By 4 DAT, virtually no damage was noted in plants treated with SNIPER; damage reduction in other treatments still exceeded 50%. By 7 DAT, while over 85% of SCB introduced to plants treated with SNIPER died, no treatment effectively reduced feeding damage.

For both pumpkin and cucumber in 1999, a single foliar application of any of the 4 tested insecticides would not have adequately protected rapidly growing seedlings throughout the vulnerable seedling stage of development. While SNIPER provided most effective protection of both cucurbits, multiple applications would have been required had SCB-pressure remained high for more than 4-5 days.

Squash - Planting Water Treatments (Table 3):
While mortality of SCB introduced onto squash leaves harvested 1 DAT was quite low, virtually no feeding damage was observed on leaves from plants growing from seedlings treated with either rate of ADMIRE. An average of 37% of the area of leaves from untreated plants was consumed in the same bioassay. By 21 DAT, while damage was reduced by just under 50% in plants treated with the lower rate of the insecticide, protection by the higher rate of planting water treatment still exceeded 85%. By 28 DAT, leaf-damage exceeded 50% for both rates of application of the planting water treatment . In microplots in 1999, imidacloprid absorbed from planting water treatments would have adequately protected growing squash seedlings from feeding by adult SCB during the vulnerable establishment period.

Table 1. Effect of foliar insecticides on damage to pumpkin seedlings by adult striped cucumber beetle, *A. vittatum* (Fabr.), in bioassay, London, ON, 1999.

Tmt. No.	Treatment	Rate (pdct/ha)	Adult Striped Cucumber Response on Indicated DAT[1]							
			Day 1[1]		Day 2		Day 4		Day 7	
			Mort.[2]	D. R.[3]	Mort.	D. R.	Mort.	D. R.	Mort.	D. R.
1	RIPCORD 400EC	87.5 ml	68.0 bc[4]	100	78.8 bc	93.8	8.3 a	29.5	2.3 a	13.9
2	THIODAN 4EC	1.5 L	75.2 c	80	60.3 b	84.6	13.6 a	30.2	2.3 a	22
3	SNIPER 50WP	1.1 kg	100.0 d	99.7	100.0 c	100	95.5 b	52.2	4.5 a	25
4	ADMIRE 240F	0.2 L	45.3 b	99.2	100.0 c	94	3.0 a	8.9	12.6 a	8.3
5	untreated	----	0.0 a	5.45	0.0 a	4.3	0.0 a	1.5	0.0 a	3

[1] Days after Treatment.

[2] Corrected % Mortality.

[3] D.R. = % Damage Reduction relative to feeding damage to leaves from untreated plots (Tmt. 5).

[4] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Fisher's protected LSD means separation test.

[5] - Actual 72-hour Damage Rating (0-10 scale where 0 represents no feeding damage, 5 represents 50% loss of leaf area, 10 represents 100% consumption of the leaf).

Table 2. Effect of foliar insecticides on damage to cucumber seedlings by adult striped cucumber beetle, *A. vittatum* (Fabr.), in bioassay, London, ON, 1999.

Tmt. No.	Treatment	Rate (pdct/ha)	Adult Striped Cucumber Response on Indicated DAT[1]							
			Day 1[1]		Day 2		Day 4		Day 7	
			Mort.[2]	D. R.[3]	Mort.	D. R.	Mort.	D. R.	Mort.	D. R.
1	RIPCORD 400EC	87.5 ml	16.0 a[4]	90.5	29.8 ab	84.2	4.8 a	74.5	16.0 a	50.3
2	THIODAN 4EC	1.5 L	12.6 a	33.3	53.9 b	72.6	29.8 b	56.4	23.3 a	20.9
3	SNIPER 50WP	1.1 kg	96.6 b	94.2	100.0 c	95.7	96.4 c	96.9	86.7 b	40.3
4	ADMIRE 240F	0.2 L	22.7 a	96.3	38.9 b	98.8	17.9 ab	87.8	16.6 a	43.1
5	untreated	----	0.0 a	3.25	0.0 a	6	0.0 a	7.8	0.0 a	5.8

[1] Days after Treatment.

[2] Corrected % Mortality.

[3] % Damage Reduction relative to feeding damage to leaves from untreated plots (Tmt. 5)

[4] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Fisher's protected LSD means separation test.

[5] Actual 72-hour Damage Rating (0-10 scale where 0 represents no feeding damage, 5 represents 50% loss of leaf area, 10 represents 100% consumption of the leaf).

Table 3. Effect of planting water treatments on damage to squash seedlings by adult striped cucumber beetle, *A. vittatum* (Fabr.), in bioassay, London, ON, 1999.

Tmt. No.	Treatment	Rate (ml/1000 plugs)	Adult Striped Cucumber Response on Indicated DAT[1]							
			Day 1[1]		Day 7		Day 14		Day 21	
			Mort.[2]	D. R.[3]	Mort.	D. R.	Mort.	D. R.	Mort.	D. R.
1	ADMIRE 240F	15	10.0 a	100	46.8 b	100	11.1 a	96.3	21.5 a	48.6
2	ADMIRE 240F	25	16.7 a	100	69.6 b	100	11.1 a	100	11.1 a	85.7
3	untreated	----	0.0 a	3.75	0.0 a	2.6	0.0 a	2.7	0.0 a	2.7

Tmt. No.	Treatment	Rate (ml/1000 plugs)	Adult Striped Cucumber Response on Indicated DAT[1]							
			Day 28		Day 35		Day 42		Day	
			Mort.[2]	D. R.[3]	Mort.	D. R.	Mort.	D. R.	Mort.	D. R.
1	ADMIRE 240F	15	19.9 a	9.1	33.0 b	49.2	0.0 a	53.8		
2	ADMIRE 240F	25	19.9 a	48.5	5.6 ab	35.6	0.0 a	28.1		
3	untreated	----	0.0 a	1.4	0.0 a	1.8	0.0 a	1.2		

[1] Days after Treatment.

[2] Corrected % Mortality.

[3] % Damage Reduction relative to feeding damage to leaves from untreated plots (Tmt. 3)

[4] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Fisher's protected LSD means separation test.

[5] Actual 72-hour Damage Rating (0-10 scale where 0 represents no feeding damage, 5 represents 50% loss of leaf area, 10 represents 100% consumption of the leaf).

1999 PMR REPORT # 46 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1252-9304

CROP: Eggplant, cv. Dusky
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
TOLMAN J H, BARR T R, MOY P and FONSECA E J A
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre (SCPFRC)
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: EVALUATION OF INSECTICIDE TREATMENTS FOR CONTROL OF COLORADO POTATO BEETLE ATTACKING EGGPLANT GROWN IN MINERAL SOIL, 1998

MATERIALS: ADMIRE 240 F (imidacloprid), THIODAN 4EC (endosulfan)

METHODS: Eggplant seedlings were grown singly in plastic propagation-plug trays each containing 12 rows of 24 plugs. On May 23, 48 hrs prior to planting, Tmt. 1 and 2 were applied at 250 kPa in 8.0 ml/plant using a hand-held, single-nozzled (8004EVS flat fan), CO_2-pressurized, R&D plot sprayer. Plants were immediately flushed with 16.0 ml/plant to rinse the insecticide from the foliage and down into the planting medium of individual plugs. All treatments (30 plants/plot) were planted on the SCPFRC-London Research Farm on May 25 in 3-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. All treatments were replicated 3 times in a randomized complete block design. All treatments except Tmt. 3 and 4 (Table 1) received 150 ml starter fertilizer (soluble 10-52-10 [N-P-K] at 2.5 g/L) in the planting hole. The desired rate of ADMIRE was added to starter solution for Tmt. 3 and 4. Individual seedlings were established in planting holes as soon as possible after adding planting water. On June 15 and 29, Tmt. 5 and 6 (Table 1) were band-applied over the rows at 250 kPa in 900 L/ha using the single-nozzled (8004EVS flat fan) R&D plot sprayer. On June 29, Tmt. 7 and 8 (Table 1) were applied at 200 kPa in 5.0 L/100 m row in a 3-5 cm band in the bottom of a 5-6 cm furrow on each side of each row; after application the furrow was filled with soil and lightly packed. To accommodate increasing growth, the centre row of plants was removed from each microplot on June 29. On August 4, to provide eggplant samples for residue analysis, Tmt. 5 was applied at 275 kPa in 900 L/ha using the single-nozzled (D-4-25 hollow cone) R&D plot sprayer. Residual effectiveness of treatments against both adult and larval insecticide-susceptible, laboratory-reared CPB was measured by bioassay. On each collection date (Tables 2, 3), a total of 6 leaves was harvested from each plot of each treatment and returned to the laboratory for bioassay. On each collection date, if CPB numbers were sufficient, a total of 9 adult-bioassays (3 bioassays/plot x 3 plots/Tmt.), each containing 1 leaf and 5 CPB adults, and 6 larval-bioassays (2 bioassays/plot x 3 plots/Tmt.), each containing 2 x 3.55 cm leaf discs and 10 first instars, was established for each treatment. Bioassays were held at 25• C, 55% RH, and 16:8 L:D photoperiod. For each set of bioassays mortality and leaf damage were recorded after 72 hrs. Mortality was corrected using Abbott's correction and then subjected to arcsin square root transformation prior to statistical analysis by analysis of variance; Least Squares Differences (LSD) were calculated and used to estimate significance of differences among treatment means. Adult-damage reduction was determined by subtracting individual bioassay damage ratings from the average CONTROL damage rating and calculating % reduction. Areas of leaf discs remaining after 72 hrs were read directly using a LI-COR portable leaf area meter; larval damage reductions were calculated by subtracting leaf-areas consumed in individual treatment bioassays from the mean leaf area consumed in CONTROL bioassays and calculating % reduction.

On June 30, to measure initial levels of imidacloprid in soil of side-dress furrow, 5 soil cores (2.5 x 15 cm) were collected from the furrow in each plot for Tmt. 7, 8. Similar samples were collected on August 17. On July 21, as soon as eggplant reached marketable size, fruit were collected for residue analysis (3 fruit/plot) from Tmt. 2-5 and 7-9. Additional eggplant were collected on August 4, 5, 7 and 10 following re-application of Tmt 5 on August 4, and on August 17 from Tmt. 2, 4 and 8. All residues of imidacloprid were determined using HPLC by the Analytical Chemistry Services Group at SCPFRC-London.

RESULTS: See Tables 2-7 below. No phytotoxicity was observed following any treatment.

RESIDUES: Results of analyses of imidacloprid residues are shown in Table 8a below. The limit of detection for imidacloprid for both soil and eggplant was 0.01 ppm. In eggplant the threshold of detection for imidacloprid was exceeded only in Tmt. 4 in fruit harvested 57 days after treatment when 0.04 ppm were recorded. For both Tmt. 2 and 3, close scrutiny of HPLC records suggested a trace of imidacloprid in eggplant respectively harvested 60 and 57 days after treatment (DAT); the response was less than that for the 0.01 ppm standard. By 84 DAT, imidacloprid could no longer be detected in fruit harvested from any treatment. Following an additional PPF- application (Tmt. 5) on August 4, no residue of imidacloprid was detected in unwashed eggplant harvested as soon as spray deposits had dried on foliage (Table 8b). In addition in this trial, no residues of imidacloprid were detected in washed eggplant harvested 1, 3 or 6 DAT (Table 8b). Initial imidacloprid-residues of 0.87 ppm in the soil of the side-dress furrow 4 DAT declined by nearly 80% to 0.18 ppm 49 DAT with ADMIRE at 10.0 ml/100 m row (Table 8a).

CONCLUSIONS: In bioassay, mortality of introduced adult and larval CPB exceeded 85% for 29 days following PPTD-application of ADMIRE (Tmts. 1, 2) (Tables 2, 3). Adult-feeding damage was reduced by at least 80% for 43 days following PPTD-application (Table 2); larval feeding damage was reduced by at least 90% until 22 days after planting (DAP) and by approximately 70% until the final bioassay, 92 DAP (Table 3). Under the conditions of the experiment, feeding by introduced adult CPB was not reduced by 70% until 3 days after application of PW-treatments (Tmts. 3, 4) (Table 2). However, within 1 day of PW-application (Tmts. 3, 4) sufficient imidacloprid had been absorbed by eggplant seedlings to provide excellent protection against introduced first instar larvae (Table 4). PW-treatments proved more persistent than PPTD-application. Feeding damage by both adult and larvae was reduced by over 85% in the final bioassay, 92 days after planting (Table 2, 3). Adult mortality exceeded 80% in the same bioassay.

Eggplant protection by SD-application of ADMIRE (Tmts. 7, 8) was not as effective as either planting treatment. Adult-feeding damage was not reduced by 80% until 7 days after treatment; adult mortality never exceeded 75% (Table 4). Reduced uptake of imidacloprid by eggplants may reflect relatively slow regrowth of disrupted roots into treated soil. CPB larvae proved more susceptible than adults to imidacloprid absorbed by eggplants following SD-application of ADMIRE (cf. Table 4, 5).

Protection of eggplant by foliar insecticide application (Tmts. 5, 6) proved quite brief. While leaves harvested as soon as spray deposits dried proved very toxic to both adult (Table 6) and larval CPB (Table

7), mortality of introduced CPB fell below 50% by 3 days after treatment in both experiments. Foliar application of THIODAN provided somewhat longer control of CPB larvae in the first trial than did ADMIRE (Table 7a).

Table 1. Experimental treatments for control of Colorado potato beetle, *Leptinotarsa decemlinata*, attacking eggplant in field microplots, London, ON, 1998.

Tmt. No.	Insecticide	Formulation	Rate Applied (product)	Method of Application
1	imidacloprid	ADMIRE 240F	30 ml/1000 plants	PPTD[1]
2	imidacloprid	ADMIRE 240F	45 ml/1000 plants	PPTD
3	imidacloprid	ADMIRE 240F	30 ml/1000 plants	PW[2]
4	imidacloprid	ADMIRE 240F	45 ml/1000 plants	PW
5	imidacloprid	ADMIRE 240F	200.0 ml/ha	PPF[3]
6	endosulfan	THIODAN 4EC	2.75 l /ha	PPF
7	imidacloprid	ADMIRE 240F	7.0 ml/100 m row	SD[4]
8	imidacloprid	ADMIRE 240F	10.0 ml/100 m row	SD
9	CONTROL	----	----	----

[1] preplant tray-drench application
[2] planting water application
[3] post plant foliar application
[4] side-dress application

Table 2. Effect of eggplant foliage on adult Colorado potato beetles after feeding for 72 hours in bioassay, planting treatments, 1998.

Tmt. No.	Treatment	Rate (ml pdct/ plant)	Method[1]	Adult CPB Response on Indicated Day after Planting									
				Day 0		Day 1		Day 3		Day 7		Day 15	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	imidacloprid	30	PPTD	100. a[6]	97.0 a	100.0 a	97.0 a	97.6 a	98.0 a	100.0 a	98.0 a	97.8 a	97.9 a
2	imidacloprid	45	PPTD	100.0 a	97.0 a	100.0 a	98.0 a	100.0 a	98.0 a	100.0 a	98.0 a	100.0 a	97.9 a
3	imidacloprid	30	PW	---[5]	---	88.9 a	64.0 b	95.2 a	97.0 a	100.0 a	99.0 a	100.0 a	97.9 a
4	imidacloprid	45	PW	---	---	97.8 a	63.0 b	100.0 a	97.0 a	100.0 a	98.0 a	100.0 a	97.9 a
9	CONTROL	----	----	0.0 b	10.07	0.0 b	10	0.0 b	10	0.0 b	9.9	0.0 b	9.5

Tmt. No.	Treatment	Rate (ml pdct/ plant)	Method[1]	Adult CPB Response on Indicated Day after Planting									
				Day 22		Day 29		Day 43		Day 64		Day 92	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	imidacloprid	30	PPTD	100.0 a	96.6 a	91.7 a	98.9 a	32.6 c	85.1 a	18.3 cd	46.0 c	19.6 cd	26.3 c
2	imidacloprid	45	PPTD	100.0 a	96.6 a	94.4 a	97.8 a	54.8 b	82.8 a	38.8 bc	74.0 b	37.2 bc	64.6 b
3	imidacloprid	30	PW	100.0 a	96.6 a	100.0 a	97.8 a	88.6 a	94.3 a	58.7 b	86.0 a	44.1 b	87.9 a
4	imidacloprid	45	PW	100.0 a	97.8 a	94.4 a	98.9 a	84.8 a	96.6 a	93.0 a	92.0 a	81.4 a	92.9 a
9	CONTROL	----	----	0.0 b	8.9	0.0 b	9.1	0.0 d	8.7	0.0 d	10	0.0 d	9.9

[1] Methods of application: PPTD - preplant tray-drench; PW - planting water treatment.

[2] Corrected % adult mortality.

[3] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[5] Bioassay not done.

[6] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a LSD means separation test.

[7] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

Table 3. Effect of eggplant foliage on Colorado potato beetle larvae after feeding for 72 hours in bioassay, planting treatments, 1998.

Tmt. No.	Treatment	Rate (ml pdct/ plant)	Method[1]	Larval CPB Response on Indicated Day after Planting									
				Day 0		Day 1		Day 3		Day 7		Day 15	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	imidacloprid	30	PPTD	100. a[6]	100.0 a	100.0 a	91.3 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
2	imidacloprid	45	PPTD	100.0 a	100.0 a	100.0 a	91.3 a	100.0 a	81.7 ab	100.0 a	100.0 a	100.0 a	100.0 a
3	imidacloprid	30	PW	---[5]	---	100.0 a	89.5 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
4	imidacloprid	45	PW	---	---	100.0 a	91.7 a	100.0 a	60.9 ab	100.0 a	100.0 a	100.0 a	100.0 a
9	CONTROL	----	----	0.0 b	3.707	0.0 b	2.77	0.0 b	3.17	0.0 b	5.3	0.0 b	0.9

Tmt. No.	Treatment	Rate (ml pdct/ plant)	Method[1]	Larval CPB Response on Indicated Day after Planting									
				Day 22		Day 29		Day 43		Day 64		Day 92	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	imidacloprid	30	PPTD	100.0 a	100.0 a	87.3 b	75.9 a	64.3 b	71.2 a	39.5 b	69.8 a	30.8 ab	90.0 a
2	imidacloprid	45	PPTD	100.0 a	100.0 a	100.0 c	75.9 a	75.0 ab	75.4 a	39.0 b	81.4 a	26.0 b	72.1 a
3	imidacloprid	30	PW	100.0 a	100.0 a	100.0 c	75.9 a	98.2 a	74.6 a	54.2 b	82.2 a	88.1 a	100.0 a
4	imidacloprid	45	PW	100.0 a	100.0 a	100.0 c	72.3 a	100.0 a	81.4 a	93.2 c	83.9 a	58.0 ab	87.8 a
9	CONTROL	----	----	0.0 b	2.66	0.0 b	1.66	0.0 c	1.18	0.0 a	2.42	0.0 b	2.29

[1] Methods of application: PPTD - preplant tray-drench; PW - planting water treatment.

[2] Corrected % larval mortality.

[3] % Damage Reduction relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[5] Bioassay not done.

[6] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a LSD means separation test.

[7] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

Table 4. Effect of eggplant foliage on Colorado potato beetle adults after feeding for 72 hours in bioassay, side-dress treatments, 1998.

Tmt. No.	Treatment	Rate (ml/ 100 m row)	Method^1	Adult CPB Response on Indicated Day after Treatment									
				Day 4		Day 7		Day 14		Day 21		Day 28	
				Mort.^{2}	D.R.^{3,4}	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
7	imidacloprid	7	SD	24.2 a^6	41.9 a	20.8 ab	82.8 a	70.4 a	90.0 a	44.4 b	72.9 b	61.2 a	87.0 a
8	imidacloprid	10	SD	28.6 a	58.1 a	35.3 a	85.1 a	74.2 a	90.0 a	68.9 a	92.7 a	72.1 a	87.0 a
9	CONTROL	----	----	0.0 a	8.67	0.0 b	8.7	0.0 b	7	0.0 c	9.6	0.0 b	10

Tmt. No.	Treatment	Rate (ml/ 100 m row)	Method^1	Adult CPB Response on Indicated Day after Treatment									
				Day 36		Day 40		Day 56		Day		Day	
				Mort.^{2}	D.R.^{3,4}	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
7	imidacloprid	7	SD	31.3 b	60.6 a	55.8 a	85.9 a	40.1 a	10.1 a				
8	imidacloprid	10	SD	53.5 a	56.6 a	44.7 a	85.9 a	51.2 a	85.9 a				
9	CONTROL	----	----	0.0 c	9.9	0.0 b	9.9	0.0 b	9.9				

[1] Method of application: SD - side-dress.

[2] Corrected % adult mortality.

[3] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[5] Bioassay not done.

[6] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a LSD means separation test.

[7] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

Table 5. Effect of eggplant foliage on Colorado potato beetle larvae after feeding for 72 hours in bioassay, side-dress treatments, 1998.

Tmt. No.	Treatment	Rate (ml/ 100 m row)	Method[1]	Larval CPB Response on Indicated Day after Treatment									
				Day 4		Day 7		Day 14		Day 21		Day 28	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
7	imidacloprid	7	SD	15.0 b[6]	0.0 a	58.3 ab	64.4 a	96.6 a	78.8 a	75.0 a	81.9 a	37.8 a	79.3 a
8	imidacloprid	10	SD	98.3 a	11.7 a	82.7 a	61.9 a	100.0 a	81.6 a	86.7 a	90.2 a	45.8 a	83.1 a
9	CONTROL	----	----	0.0 c	3.007	0.0 b	1.18	0.0 b	2.55	0.0 b	3.26	0.0 b	2.42

Tmt. No.	Treatment	Rate (ml/ 100 m row)	Method[1]	Larval CPB Response on Indicated Day after Treatment									
				Day 36		Day 40		Day 56		Day		Day	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
7	imidacloprid	7	SD	32.4 a	85.5 a	31.0 b	0.0 b	30.8 ab	87.3 a				
8	imidacloprid	10	SD	49.4 a	77.9 a	87.5 a	87.2 a	61.2 a	98.7 a				
9	CONTROL	----	----	0.0 a	2.35	0.0 b	2.18	0.0 b	2.29				

[1] Method of application: SD - side-dress.

[2] Corrected % larval mortality.

[3] % Damage Reduction relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[5] Bioassay not done.

[6] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a LSD means separation test.

[7] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

Table 6a. Effect of eggplant foliage on Colorado potato beetle adults after feeding for 72 hours in bioassay, first post-plant foliar treatments, 15 June 1998.

Tmt. No.	Treatment	Rate (ml pdct/ ha)	Method^1	Adult CPB Response on Indicated Day after Treatment									
				Day 0		Day 1		Day 2		Day 3		Day 7	
				Mort.^{2}	D.R.^{3,4}	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
5	imidacloprid	200	PPF	100. a^6	94.3 a	82.4 a	95.9 a	---^{5}	---	50.0 a	91.9 a	11.1 a	11.0 a
6	endosulfan	2,750.0	PPF	100.0 a	82.0 b	67.2 a	92.9 a	---	---	5.5 a	61.6 b	5.6 ab	6.6 a
9	CONTROL	----	----	0.0 b	8.9^7	0.0 b	9.8	---	---	0.0 a	9.9	0.0 b	9.1

Table 6b. Effect of eggplant foliage on Colorado potato beetle adults after feeding for 72 hours in bioassay, second post-plant foliar treatments, 29 June 1998.

Tmt. No.	Treatment	Rate (ml pdct/ ha)	Method^1	Adult CPB Response on Indicated Day after Treatment									
				Day 0		Day 1		Day 4		Day 7		Day	
				Mort.^{2}	D.R.^{3,4}	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
5	imidacloprid	200	PPF	92.1 a	96.3 a	55.4 a	89.5 a	17.9 a	58.1 a	10.7 a	36.8 a		
6	endosulfan	2750	PPF	100.0 a	92.7 a	3.7 b	55.3 b	0.0 a	30.2 a	3.4 a	26.4 a		
9	CONTROL	----	----	0.0 b	8.2	0.0 b	7.6	0.0 a	8.6	0.0 a	8.7		

---

[1] Method of application: PPF - post-plant foliar.

[2] Corrected % adult mortality.

[3] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[5] Bioassay not done.

[6] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a LSD means separation test.

[7] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

Table 7a. Effect of eggplant foliage on Colorado potato beetle larvae after feeding for 72 hours in bioassay, first post-plant foliar treatments, 15 June 1998.

Tmt. No.	Treatment	Rate (ml pdct/ ha)	Method[1]	Larval CPB Response on Indicated Day after Treatment									
				Day 0		Day 1		Day 2		Day 3		Day 7	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
5	imidacloprid	200	PPF	100. a[6]	100.0 a	73.3 a	82.6 a	90.2 a	88.7 a	15.7 b	54.7 a	8.5 a	57.2 a
6	endosulfan	2750	PPF	100.0 a	100.0 a	100.0 a	67.0 a	96.2 a	84.3 a	98.2 a	73.2 a	21.2 a	33.7 a
9	CONTROL	----	----	0.0 b	2.667	0.0 b	1	0.0 b	0.53	0.0 c	1.79	0.0 a	1.66

Table 7b. Effect of eggplant foliage on Colorado potato beetle larvae after feeding for 72 hours in bioassay - second post-plant foliar treatments, 29 June 1998.

Tmt. No.	Treatment	Rate (ml pdct/ ha)	Method[1]	Larval CPB Response on Indicated Day after Treatment							
				Day 0		Day 1		Day 4		Day 7	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
5	imidacloprid	200	PPF	---[5]	---	---	---	33.3 a	25.3 a	11.3 a	9.3 a
6	endosulfan	2750	PPF	---	---	---	---	40.7 a	0.0 b	23.2 a	2.5 a
9	CONTROL	----	----	---	---	---	---	0.0 b	3	0.0 a	1.18

[1] Method of application: PPF - post-plant foliar.

[2] Corrected % larval mortality.

[3] % Damage Reduction relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 9).

[5] Bioassay not done.

[6] - Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a LSD means separation test.

[7] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

Table 8a: Imidacloprid-residues measured in soil and eggplant samples - first applications, 1998.

Tmt. No.	Rate Applied (pdct)	Method[1]	Measured Residue (ppm) on Indicated DAT[2]			
			Soil		Eggplant	
2	45.0 ml[6]	PPTD	NP[3]	NP	<0.01[4] (60)[5]	<0.01 (87)
3	30.0 ml[6]	PW	NP	NP	<0.01 (57)	NP
4	45.0 ml[6]	PW	NP	NP	0.04 (57)	<0.01 (84)
5	200.0 ml[7]	PPF	NP	NP	<0.01 (22)	NP
7	7.0 ml[8]	SD	0.67 (1)	0.16 (49)	<0.01 (22)	NP
8	10.0 ml[8]	SD	0.87 (1)	0.18 (49)	<0.01 (22)	<0.01 (49)
9	---	---	<0.01	NP	<0.01	NP

Table 8b: Imidacloprid-residues measured in soil and eggplant samples - second application, 4 August 1998.

Tmt. No.	Rate Applied (pdct)	Method[1]	Measured Residue (ppm) on Indicated DAT[2]			
			9	1	3	6
5	200.0 ml[7]	PPF	<0.01	<0.01	<0.01	<0.01

[1] Methods of application. Refer to Table 1.

[2] Days after Treatment.

[3] Residue analysis not performed.

[4] Limit of detection.

[5] Numbers in parentheses indicate the number of days after application of imidacloprid to eggplant seedlings/plants.

[6] ml product/1,000 plants.

[7] ml product/ha.

[8] ml product/100 m row.

[9] Residues measured in both eggplant washed with water prior to processing and extraction and in eggplant not washed prior to similar processing and extraction.

1999 PMR REPORT # 47 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1252-9904

CROP: Eggplant, cv. Dusky
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
TOLMAN J H, BARR T R and McANINCH A L
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre (SCPFRC)
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: EVALUATION OF PLANTING TREATMENTS FOR CONTROL OF COLORADO POTATO BEETLE ATTACKING EGGPLANT GROWN IN MINERAL SOIL, 1999

MATERIALS: ADMIRE 240 F (imidacloprid), ACTARA 25 WG (thiamethoxam)

METHODS: Eggplant seedlings were grown singly in plastic propagation-plug trays each containing 12 rows of 24 plugs. On May 28, 3 hrs prior to planting, Tmts. 1-3 (Table 1) were applied at 250 kPa in 4.0 ml/plant using a hand-held, single-nozzled (8004EVS flat fan), CO_2-pressurized, R&D plot sprayer. Plants were immediately flushed with 8.0 ml water/plant to rinse the insecticide from the foliage and down into the planting medium of individual plugs. All treatments (30 plants/plot) were planted on the SCPFRC-London Research Farm on May 28 in 3-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. All treatments were replicated 3 times in a randomized complete block design. All treatments except Tmt. 4 and 5 received 150 ml starter fertilizer (soluble 10-52-10 [N-P-K] at 2.5 g/L) in the planting hole. The desired rate of ADMIRE was added to starter solution for Tmt. 4 and 5. Individual seedlings were established in planting holes as soon as possible after adding planting water. To accommodate increasing growth, the centre row of plants was removed from each microplot on July 6. To supplement scanty rainfall, microplots received 25 mm water via sprinkler-irrigation on June 11, 23, July 7, 13 and 27. Residual effectiveness of treatments against both adult and larval insecticide-susceptible, laboratory-reared CPB was measured by bioassay. On each collection date (Tables 2, 3), a total of 6 leaves was harvested from each plot of each treatment and returned to the laboratory for bioassay. On each collection date, if CPB numbers were sufficient, a total of 9 adult-bioassays (3 bioassays/plot x 3 plots/Tmt.), each containing 1 leaf and 5 CPB adults, and 6 larval-bioassays (2 bioassays/plot x 3 plots/Tmt.), each containing 2 x 3.55 cm leaf discs and 10 first instars, was established for each treatment. Bioassays were held at 25• C, 55% RH, and 16:8 (L:D) photoperiod. For each set of bioassays, mortality and leaf damage were recorded after 72 hrs. Mortality was corrected using Abbott's correction and then subjected to arcsin square root transformation prior to statistical analysis by analysis of variance; Tukey's HSD Multiple Comparison was used to estimate significance of differences among treatment means. Where appropriate, untransformed data are presented in the following tables. Adult-damage reduction was determined by subtracting individual bioassay damage ratings from the average CONTROL damage rating and calculating % reduction. Areas of leaf discs remaining after 72 hrs were read directly using a LI-COR portable leaf area meter; larval damage reductions were calculated by subtracting leaf-areas consumed in individual treatment bioassays from the mean leaf area consumed in

CONTROL bioassays and calculating % reduction.

On July 15, as soon as eggplant reached marketable size, fruit were collected for residue analysis (3 fruit/plot) from all treatments. Additional eggplant were collected on August 4 from Tmt. 2, 3 and 5. Eggplant were delivered to the laboratory of the Analytical Chemistry Services Group in the London laboratory of the SCPFRC for HPLC-determination of levels of imidacloprid and thiamethoxam.

RESULTS: See Tables 2-3 below. No phytotoxicity was observed following any treatment.

RESIDUES: Results of analyses of insecticide-residues in eggplant are not yet available.

CONCLUSIONS: In bioassay, mortality of introduced adult and larval CPB exceeded 70% for 33 and 40 days respectively following PPTD-application of ADMIRE (Tmts. 1, 2) (Tables 2,3). Adult-feeding damage was reduced by at least 80% for 33 days following PPTD-application of the higher rate of application of ADMIRE (Table 2); larval feeding damage following PPTD-application of ADMIRE at 30 ml/1000 plants was reduced by at least 70% until 47 days after planting (DAP)(Table 3). With the exception of 26 DAP, foliage from eggplant treated PPTD with ACTARA killed at least 70% of introduced CPB adults until 54 DAP (Table 2); adult feeding damage was reduced at least 70% by ACTARA until the final bioassay, 81 DAP (Table 2). With the exception of 47 DAP, larval mortality and feeding damage reduction exceed 70% until 74 DAP (Table 3). Beyond 47 DAP, PW-application of ADMIRE provided arithmetically, if not always statistically, better control of adult and larval CPB than did PPTD- application of the same rate of the insecticide (cf Tables 2, 3). For all treatments later in the season, we often recorded improved control relative to the preceding sampling period. While more work is required to prove the hypothesis, we suspect that increased late-season insecticide effectiveness may follow resumed plant growth following irrigation or rainfall.

Table 1. Experimental treatments for control of Colorado potato beetle, *Leptinotarsa decemlinata*, attacking eggplant in field microplots, London, ON, 1999.

Tmt. No.	Insecticide	Formulation	Rate Applied (product)	Method of Application
1	imidacloprid	ADMIRE 240F	20 ml/1000 plants	PPTD
2	imidacloprid	ADMIRE 240F	30 ml/1000 plants	PPTD
3	thiamethoxam	ACTARA 25WG	18 g/1000 plants	PPTD
4	imidacloprid	ADMIRE 240F	20 ml/1000 plants	PW
5	imidacloprid	ADMIRE 240F	30 ml/1000 plants	PW
6	untreated	CONTROL	----	-----

[1] preplant tray-drench application

[2] planting water application

Table 2. Effect of treated eggplant foliage on adult Colorado potato beetles after feeding for 72 hours in bioassay, planting treatments, 1999.

Tmt No.	Treatment	Rate (pdct/ plant)	Method[1]	Adult CPB Response on Indicated Day after Planting									
				Day 4		Day 11		Day 19		Day 26		Day 33	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE	20 ml	PPTD	100.0 b[5]	97.8 c	100.0 b	98.9 b	97.7 b	96.3 b	100.0 b	98.2 cd	73.3 b	62.5 b
2	ADMIRE	30 ml	PPTD	100.0 b	97.4 c	100.0 b	98.5 b	97.7 b	96.4 b	97.4 b	96.0 b	71.1 b	84.8 bc
3	ACTARA	18 g	PPTD	100.0 b	89.5 b	100.0 b	98.3 b	100.0 b	96.3 b	100.0 b	96.7 bc	66.7 b	71.9 bc
4	ADMIRE	20 ml	PW	100.0 b	95.2 c	100.0 b	98.2 b	100.0 b	98.0 c	94.9 b	98.8 d	67.8 b	88.3 c
5	ADMIRE	30 ml	PW	100.0 b	95.4 c	100.0 b	98.9 b	95.4 b	98.2 c	94.9 b	98.7 d	53.3 b	95.0 c
6	untreated	----	----	0.0 a	9.96	0.0 a	9.7	0.0 a	9.3	0.0 a	9.4	0.0 a	9.5

Tmt No.	Treatment	Rate (pdct/ plant)	Method[1]	Adult CPB Response on Indicated Day after Planting									
				Day 40		Day 47		Day 54		Day 68		Day 81	
				Mort.[2]	D.R.[3,4]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE	20 ml	PPTD	66.5 b	77.6 b	55.2 bc	45.7 b	74.4 c	57.8 bc	52.3 b	51.8 b	21.1 a	34.6 b
2	ADMIRE	30 ml	PPTD	55.1 b	67.2 b	35.1 b	55.6 bc	48.9 b	36.7 b	50.0 b	58.9 bc	64.4 b	61.4 bc
3	ACTARA	18 g	PPTD	75.5 b	75.4 b	71.0 bc	78.3 c	95.9 c	84.4 cd	68.4 b	76.7 bc	62.2 b	87.7 c
4	ADMIRE	20 ml	PW	73.0 b	86.2 b	90.3 c	87.5 c	88.9 c	87.4 d	71.6 bc	79.4 bc	86.7 b	68.7 bc
5	ADMIRE	30 ml	PW	94.9 b	92.1 b	74.2 bc	89.0 c	95.6 c	92.7 d	100.0 c	87.2 c	86.7 b	87.7 c
6	untreated	----	----	0.0 a	8.8	0.0 a	9	0.0 a	9.9	0.0 a	10	0.0 a	9.9

[1] Methods of application: PPTD - preplant tray-drench; PW - planting water treatment; [2] Corrected % adult mortality; [3] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[4] Relative to feeding damage in leaves from CONTROL plots (Tmt. 6).

[5] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison.

[6] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

Table 3. Effect of eggplant foliage on Colorado potato beetle larvae after feeding for 72 hours in bioassay, planting treatments, 1999.

Tmt No.	Treatment	Rate (pdct/ plant)	Method[1]	Larval CPB Response on Indicated Day after Planting									
				Day 19		Day 26		Day 33		Day 40		Day 47	
				Mort.[2]	D.R.[3]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE	20 ml	PPTD	100.0 b[4]	100.0 b	100.0 b	99.8 c	100.0 b	83.2 bc	100.0 b	89.5 b	5.2 ab	44.5 ab
2	ADMIRE	30 ml	PPTD	100.0 b	100.0 b	96.7 b	94.5 b	92.9 b	78.4 b	85.7 b	82.1 b	36.7 b	70.1 b
3	ACTARA	18 g	PPTD	100.0 b	100.0 b	98.3 b	98.6 bc	100.0 b	89.2 bc	92.0 b	85.3 b	65.0 b	86.5 b
4	ADMIRE	20 ml	PW	100.0 b	100.0 b	98.3 b	98.9 bc	100.0 b	93.9 bc	100.0 b	95.4 b	28.9 b	69.1 b
5	ADMIRE	30 ml	PW	100.0 b	100.0 b	100.0 b	99.5 bc	100.0 b	94.5 c	98.0 b	95.5 b	58.3 b	96.6 b
6	untreated	----	----	0.0 a	7.45	0.0 a	2.4	0.0 a	4	0.0 a	2.6	0.0 a	3.5

Tmt. No.	Treatment	Rate (pdct/ plant)	Method[1]	Larval CPB Response on Indicated Day after Planting									
				Day 54		Day 61		Day 68		Day 74		Day 81	
				Mort.[2]	D.R.[3]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE	20 ml	PPTD	69.4 b[4]	93.6 b	46.4 b	70.8 b	26.7 a	62.9 b	14.7 a	45.8 b	46.2 b	74.6 b
2	ADMIRE	30 ml	PPTD	38.9 a	43.6 a	64.5 b	90.4 b	80.0 b	80.8 b	14.3 a	32.0 ab	80.8 b	86.3 b
3	ACTARA	18 g	PPTD	74.5 b	94.3 b	82.1 b	87.5 b	91.7 b	93.6 b	81.8 b	96.2 c	50.9 b	57.6 b
4	ADMIRE	20 ml	PW	86.4 b	98.8 b	85.7 b	94.7 b	88.3 b	95.0 b	67.1 b	95.0 c	75.6 b	78.1 b
5	ADMIRE	30 ml	PW	63.6 b	98.7 b	85.7 b	96.6 b	100.0 b	96.5 b	92.9 b	99.9 c	92.3 c	94.9 b
6	untreated	----	----	0.0 a	4.6	0.0 a	3.9	0.0 a	4.9	0.0 a	3.5	0.0 a	3.8

[1] Methods of application: PPTD - preplant tray-drench; PW - planting water treatment.

[2] Corrected % larval mortality.

[3] % Damage Reduction relative to feeding damage in leaves from CONTROL plots (Tmt. 6).

[4] Means within a column followed by the same letter are not significantly different ($P = 0.05$) as determined using Tukey's HSD Multiple Comparison.

[5] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

1999 PMR REPORT # 48 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1241-9580

CROP: Flue-cured tobacco, cv. Delfield
PEST: Tobacco aphid (TA), *Myzus nicotianae*

NAME AND AGENCY:
TOLMAN J H and MURCHIE K J
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: **COMPARISON OF EFFECTIVENESS OF "PLANTING", SIDE-DRESS AND "SUCKER" APPLICATION OF INSECTICIDES FOR CONTROL OF APHIDS ATTACKING FLUE-CURED TOBACCO, 1999**

MATERIALS: ADMIRE 240 F (imidacloprid), ORTHENE 75 SP, 97 SP (acephate), PFIZOL-10 81% (N-decanol)(sucker control agent)

METHODS: Control of TA by several methods of insecticide application was investigated on the Delhi Research Farm of the Southern Crop Protection and Food Research Centre. Experimental treatments are described in Table 1. With the exception of Tmts. 1 and 2, tobacco seedlings were grown in a glass-greenhouse in muck seedbeds precision-seeded with pelletized seed on April 1. Seedlings for Tmts. 1 and 2 were grown singly in Berger BM-2 propagation media in 288-cell Styrofoam float trays placed in the float tanks in a double poly-house on March 23. On May 20, Tmts. 1 and 2 were applied at 200 kPa in 80 L/100 m^2 and washed from tobacco foliage into the propagation media with 240 L/100 m^2 water, using a hand-held, single-nozzled, CO_2-pressurized, R&D precision sprayer fitted with an 8004EVS flat fan spray tip. Tobacco seedlings had been clipped to a height of 15-18 cm. On May 25, all treatments were transplanted with a single row Delhi Foundry planter in a randomized complete block design with 4 replications. Each plot contained 4 rows of 36 plants; only the centre 2 rows were treated and subsequently sampled for bioassay. All treatments received 150 ml clear transplant water/plant. On June 20, using a V-blender, insecticide for Tmts. 6 and 7 was diluted with water and coated onto 9-4-30 (N-P-K) fertilizer by tumbling for 10 minutes. On June 24, Tmts. 3-5 were applied in a 5-cm band on top of side-dress fertilizer at 200 kPa in 3 L/100 m via a single TG2 hollow cone nozzle mounted on the shank of each fertilizer shoe. Side-dress fertilizer, coated with insecticide (Tmts. 6, 7), was applied on the same date. On July 20 and 28, Tmts. 8 and 9 were applied to topped tobacco at 100 kPa in 450 L/ha using a HAHN HI-BOY high clearance sprayer travelling at 5.5 km/h, and equipped with a 3-nozzle boom over each row; each boom was fitted with 1 x TG5 full cone spray tip centred over the row and 1 x TG3 full cone spray tip directed downwards at 45• on either end of the 0.7 m boom. Residual effectiveness of all treatments was measured by bioassay at varying times after application. On each assay date, 5-cm diameter leaf discs were punched from either the youngest leaf large enough to permit collection of a sample without severing the mid-rib or from the third leaf from the severed top of the stalk. On each collection date a total of 12 bioassays (3 bioassays/plot x 4 plots/tmt.) was established for each treatment. Each bioassay contained 1 leaf disc on 50 cc moist (7% wt/wt) silica sand and 10 mature, wingless TA from a stock culture maintained in the laboratory. Bioassays were held at 23• C, 60% RH, and 16:8 L:D photoperiod. For each set of bioassays, mortality and the number of nymphs produced were recorded after 72 hrs. The number of nymphs/surviving TA was then calculated for each bioassay. Mortality was calculated using Abbott's correction and then subjected to arcsin square root transformation prior to analysis. Where appropriate, untransformed data are presented in the following tables. Field-effectiveness of insecticide application was rated on August 20. In each plot, the numbers of plants with a CORESTA aphid-infestation rating >6 (>621 TA/plant) in 1 border-row and in the adjacent treatment-row were counted.. The %-Infestation for each row was calculated and the effect of insecticide treatment in each plot calculated using the formula: % Change = % Infested Plants (border- row) - % Infested Plants (treatment-row) / % Infested Plants (border-row) x 100. Statistical significance of effect of treatments was determined by analysis of variance. Tukey's HSD test was used to estimate significance of recorded differences among treatment means.

RESULTS/OBSERVATIONS: Throughout most of the growing season, field TA-populations were too low and too uneven to permit collection of meaningful field data. Results of measurement by bioassay of effectiveness of planting (PrePlant Tray-Drench [TD]) treatments are shown in Tables 2a and 2b. Results of similar measurement of effectiveness of side-dress (SD, FA) treatments are outlined in Tables 3a and 3b. Tables 4a, 4b, 5a and 5b detail results of bioassay of persistence of effectiveness of 2 applications of insecticide in combination with a sucker control agent (SA-treatments). Results of field-estimation of late-season effect of insecticide treatment on TA-populations are summarized in Table 6.

TD-application of ORTHENE (Tmt. 2) resulted in noticeable damage to float transplants. Typical symptoms of acephate-injury, ie. brownish leaf margins and brownish discolouration of leaf lamella between veins, were observed on greenhouse leaves on transplants in the field 7 days after planting. While plants finally grew through the injury, topping was delayed in some plots. No damage was noted following any other treatment.

CONCLUSIONS: TD-application of ADMIRE proved much more effective than similar application of ORTHENE. As long as 47 days after planting (DAP), bioassay-mortality exceeded 90% in TA on leaf discs from tobacco drenched with ADMIRE in the greenhouse (Table 2a). Production of nymphs by surviving TA by TD-application of ADMIRE was significantly reduced as long as 54 DAP (Table 2b). TD-application of ORTHENE did not have a pronounced impact on either TA-survival or productivity in any bioassay of insecticidal activity.

In an effort to extend the window of protection provided by the systemic activity of both imidacloprid (ADMIRE) and acephate (ORTHENE 75SP) applied in the soil, both insecticides were applied in the furrow on top of side-dress fertilizer on June 24. ADMIRE was coated directly onto side-dress fertilizer in 2 other sets of plots. As early as 5 days after treatment (DAT), significant mortality of introduced TA was recorded in bioassays of leaves harvested from tobacco receiving SD-application of ORTHENE 75SP and the lower rate of ADMIRE (Table 3a). Significantly fewer nymphs were also produced in these bioassays and in bioassays for plants receiving SD-application of fertilizer treated with ADMIRE @ 7 ml/100 m row (Table 3b). By 12 DAT, significantly fewer nymphs were recorded in bioassays for all SD-treatments. Significant mortality was recorded for all SD-treatments except Tmt. 7 (Table 3a). By 19 DAT, SD-application of ORTHENE 75SP no longer caused significant mortality of introduced TA (Table 3a). As late as 33 DAT, both SD- and FA- application of ADMIRE @ 10 ml/100 m caused slight but significant mortality of introduced TA (Table 3a). TA-productivity was also reduced by a significant 39% for as long as 33 DAT in bioassays from tobacco treated with ADMIRE @ 10 ml/100 m row (Table 3b).

Thus, as observed in 1998 (Tolman *et al.*, 1998), activity of SD-application of ADMIRE did not persist as long after treatment as after planting application of the insecticide. However, when the overall development of the tobacco plant is considered, leaf discs from plants receiving SD-application of the insecticide proved toxic to introduced TA later in the season than discs from tobacco receiving TD-application. Under field conditions, SD-application of ADMIRE could thus delay the first application of insecticide for control of the pest.

Sucker-application (SA) of both formulations of ORTHENE significantly reduced both survival and productivity of TA introduced into bioassays at varying times after treatment. Following the second application, as long as 20 DAT significant mortality of introduced TA was recorded in bioassays of leaves from tobacco treated with ORTHENE (Table 5a). TA-productivity, however, was significantly reduced for only 9 DAT (Table 5b). No significant difference was observed between activity of ORTHENE 75SP and ORTHENE 97SP applied in combination with the sucker control agent.

Higher TA populations developed in field plots relatively late in the season. On August 20 in every treatment, an average of at least 12 plants in untreated border rows received a CORESTA rating > 6 (>621 TA/plant) (Table 6). No significant difference was recorded in the number of infested plants/untreated border-row (Table 6). In spite of considerable field variation in the TA-population among plots, for all treatments except both TD-treatments (Tmt. 1, 2) and SD-application of ORTHENE 75SP (Tmt. 5), significantly fewer infested plants were recorded in treatment rows of treated plots than in adjacent border rows of the same plots (Table 6). Even in untreated plots (Tmt. 10), the mean TA-infestation was approximately 28% lower in middle rows than in border rows (Table 6). Levels of infestation similar to untreated plots were noted for TD- (Tmt. 2) and SD- (Tmt. 5) application of ORTHENE 75SP. For other treatments, average TA-reductions in treatment rows ranged from 66% to 100% (Table 6). As long as 92 DAT, the mean TA-infestation in treatment rows of plots planted with tobacco drenched in the greenhouse with ADMIRE (Tmt. 1), was 84% lower than in adjacent border rows (Table 6).

RESIDUE ANALYSIS: Samples of dried tobacco from all ADMIRE-treatments have been collected to determine whether imidacloprid could be detected after curing and processing. Analyses are not yet complete.

Table 1. Experimental field treatments for control of tobacco aphid, *Myzus nicotianae*, Delhi, ON, 1999.

Tmt. No.	Material(s) Applied	Application Type	Rate(s) Applied
1	ADMIRE 240F	pre-plant tray drench (TD)	30.0 ml/1000 plants
2	ORTHENE 75SP	pre-plant tray drench (TD)	75.0 g/1000 plants
3	ADMIRE 240F	side-dress (SD)	7.0 ml/100 m
4	ADMIRE 240F	side-dress (SD)	10.0 ml/100 m
5	ORTHENE 75SP	side-dress (SD)	15.0 g/100 m
6	ADMIRE 240F	fertilizer applic'n (FA)	7.0 ml/100 m
7	ADMIRE 240F	fertilizer applic'n (FA)	10.0 ml/100 m
8	ORTHENE 75SP+ PFIZOL 10	sucker-application (SA)	1100 g /ha + 16.8 L /ha
9	ORTHENE 97SP+ PFIZOL 10	sucker-application (SA)	850.5 g/ha + 16.8 L /ha
10	CONTROL	----	----

Table 2a. Effect of "planting" treatments on mortality of introduced tobacco aphid, *Myzus nicotianae*, in bioassay, Delhi, ON, 1999.

Tmt. No.	Treatment Applied	Method[1]	Rate (/1000 plants)	Mean Corrected Mortality on Indicated Day after Planting					
				25	32	40	47	54	61
1	ADMIRE 240F	TD	30.0 ml	24.8 b[2]	78.1 b	58.9 c	90.3 b	14.5 b	1.8 a
2	ORTHENE 75SP	TD	75.0 g	2.6 a	2.9 a	18.1 b	14.3 a	xx[3]	xx
10	untreated	---	----	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

Table 2b. Effect of "planting" treatments on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae*, in bioassay, Delhi, ON, 1999.

Tmt. No.	Treatment Applied	Method[1]	Rate (/1000 plants)	Mean No. Living Nymphs/Surviving Female on Indicated Day after Planting					
				25	32	40	47	54	61
1	ADMIRE 240F	TD	30.0 ml	0.1 a	2.6 a	2.9 a	2.5 a	4.5 a	10.1 a
2	ORTHENE 75SP	TD	75.0 g	1.8 b	8.2 b	6.4 b	6.0 a	xx	xx
10	untreated	---	----	1.9 b	7.9 b	4.2 a	5.8 a	11.4 b	11.3 a

[1] Method of Application: TD - pre-plant tray drench.

[2] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD multiple comparisons test.

[3] Bioassay not done due to high survival of introduced TA in preceding series of tests.

Table 3a. Effect of side-dress treatments on mortality of introduced tobacco aphid, *Myzus nicotianae*, in bioassay, Delhi, ON, 1999.

Tmt. No.	Treatment Applied	Method[1]	Rate (pdct/100 m)	Mean Corrected Mortality on Indicated Day after Treatment					
				5	12	19	26	33	39
3	ADMIRE 240F	SD	7.0 ml	49.6 b[2]	58.7 b	34.7 c	7.9 a	0.0 a	xx[3]
4	ADMIRE 240F	SD	10.0 ml	20.5 a	74.8 b	27.2 bc	36.0 b	19.6 b	xx
5	ORTHENE 75SP	SD	15.0 g	87.3 c	55.6 b	8.3 ab	0.0 a	xx	xx
6	ADMIRE 240F	FA	7.0 ml	19.2 a	44.0 b	17.6 bc	1.3 a	10.8 b	xx
7	ADMIRE 240F	FA	10.0 ml	5.0 a	32.9 ab	25.0 bc	7.9 a	5.9 ab	3.1 b
10	untreated	---	----	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

[1] Method of Application: SD - side-dress; FA - insecticide impregnated onto side-dress fertilizer.

[2] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD multiple comparisons test.

[3] Bioassay not done due to high survival of introduced TA in preceding series of tests.

Table 3b. Effect of side-dress treatments on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae*, in bioassay, Delhi, ON, 1999.

Tmt. No.	Treatment Applied	Method[1]	Rate (/100 m)	Mean No. Living Nymphs/Surviving Female on Indicated Day after Treatment					
				5	12	19	26	33	39
3	ADMIRE 240F	SD	7.0 ml	1.5 a[2]	2.2 a	3.6 a	8.0 b	8.9 b	xx[3]
4	ADMIRE 240F	SD	10.0 ml	2.2 ab	0.6 a	3.2 a	8.4 bc	6.8 ab	xx
5	ORTHENE 75SP	SD	15.0 g	0.3 a	1.2 a	7.1 b	9.9 bc	xx	xx
6	ADMIRE 240F	FA	7.0 ml	1.5 a	1.9 a	3.0 a	7.8 b	6.5 ab	xx
7	ADMIRE 240F	FA	10.0 ml	2.0 ab	1.2 a	1.7 a	4.3 a	5.4 a	8.2 a
10	untreated	---	----	4.2 b	5.8 b	11.4 c	11.3 c	8.9 b	7.1 a

[1] Method of Application: SD - side-dress; FA - insecticide impregnated onto side-dress fertilizer.

[2] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD multiple comparisons test.

[3] Bioassay not done due to high survival of introduced TA in preceding series of tests.

Table 4a. Effect of sucker-application treatments on mortality of introduced tobacco aphid, *Myzus nicotianae*, in bioassay following first application, July 20, 1999.

Tmt. No.	Treatment[1] Applied	Rate (pdct/ha)	Mean Corrected Mortality on Indicated Day after Treatment		
			1	3	6
8	ORTHENE 75SP	1,100.0 g	91.1 b[2]	95.6 b	70.6 b
9	ORTHENE 97SP	850.5 g	94.7 b	89.4 b	78.1 b
10	untreated	----	0.0 a	0.0 a	0.0 a

Table 4b. Effect of sucker-application treatments on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae*, in bioassay following first application, July 20, 1999.

Tmt. No.	Treatment[1] Applied	Rate (pdct/ha)	Mean No. Living Nymphs/Surviving Female on Indicated Day after Treatment		
			1	3	6
8	ORTHENE 75SP	1,100.0 g	0.7 a[2]	1.8 a	2.6 a
9	ORTHENE 97SP	850.5 g	0.5 a	0.5 a	2.6 a
10	untreated	----	8.2 b	7.1 b	7.1 b

[1] All treatments tank-mixed with 16.8 L/ha PFIZOL 10.

[2] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD multiple comparisons test.

Table 5a. Effect of sucker-application treatments on mortality of introduced tobacco aphid, *Myzus nicotianae*, in bioassay following second application, July 28, 1999.

Tmt. No.	Treatment[1] Applied	Rate (pdct./ha)	Mean Corrected Mortality on Indicated Day after Treatment					
			0	2	5	9	12	20
8	ORTHENE 75SP	1,100.0 g	87.1 b[2]	99.1 b	84.8 b	76.6 b	57.1 b	11.8 ab
9	ORTHENE 97SP	850.5 g	84.5 b	95.7 b	87.4 b	61.0 b	45.1 b	19.1 ab
10	untreated	----	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

Table 5b. Effect of sucker-application treatments on production of living nymphs by introduced tobacco aphid, *Myzus nicotianae*, in bioassay following second Application, July 28, 1999.

Tmt. No.	Treatment[1] Applied	Rate (pdct./ha)	Mean No. Living Nymphs/Surviving Female on Indicated Day after Treatment					
			0	2	5	9	12	20
8	ORTHENE 75SP	1,100.0 g	0.2 a	0.3 a	0.9 a	1.6 a	3.2 a	5.3 a
9	ORTHENE 97SP	850.5 g	0.6 a	0.4 a	1.8 a	3.1 a	5.5 a	7.3 a
10	untreated	----	5.0 b	6.9 b	4.7 b	8.5 b	5.8 a	5.1 a

[1] All treatments tank-mixed with 16.8 L/ha PFIZOL 10.

[2] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD multiple comparisons test.

Table 6: Field-control of tobacco aphid, *Myzus nicotianae*, by insecticide application, Delhi, ON, 1999.

Tmt. No.	Insecticide Applied	Method[1]	Rate Applied (pdct)	Mean # Infested[2] Plants for Indicated Row		% Reduction in Infestation	DAT[6]
				Border[3]	Treated[4]		
1	ADMIRE 240F	TD	30 ml/1000 plants	13.8 a[7]	2.5 ab	84.2	92
2	ORTHENE 75SP	TD	75 g/1000 plants	17.8 a	17.8 b	24.8	92
3	ADMIRE 240F	SD	7 ml/100 m	15.0 a	2.0 a	66	57
4	ADMIRE 240F	SD	10 ml/100 m	20.8 a	0.8 a	97.4	57
5	ORTHENE 75SP	SD	15 g/100 m	16.5 a	12.0 ab	26.6	57
6	ADMIRE 240F	FA	7 g/100 m	18.3 a	1.3 a	93.2	57
7	ADMIRE 240F	FA	10 g/100 m	12.0 a	1.8 a	89.5	57
8	ORTHENE 75SP	SA[8]	1,100 g/ha	15.3 a	0.8 a	95	16
9	ORTHENE 97SP	SA[8]	850.5 g/ha	13.8 a	0.0 a	100	16
10	untreated	---	---	14.8 a	17.8 b	27.5	--

[1] Method of Application. Refer to Table 1.

[2] Tobacco plants with CORESTA-aphid rating >6.0 (>621 aphids/plant).

[3] Untreated border row at edge of plot.

[4] Treatment row adjacent to rated border row.

[5] % Reduction in Infestation was calculated separately for each plot of each treatment. % Reductions shown are the means of the 4 values for each treatment and not the reductions calculated using the mean infestations in each treatment.

[6] Days after last application of indicated insecticide.

[7] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD multiple comparisons test.

[8] Treatments tank-mixed with 16.8 L/ha PFIZOL 10.

1999 PMR REPORT # 49 SECTION B: INSECTS OF VEGETABLES AND SPECIAL CROPS
STUDY DATA BASE: 280-1241-9911

CROP: North American ginseng, *Panax quinquefolius* L.
PEST: Leafroller (LR), *Archips purpurana* (Clemens)

NAME AND AGENCY:
TOLMAN J H, GROHS R , MURCHIE K J and HENNING K V
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
P.O. Box 186, 711 Schafer Road, Delhi, Ontario N4B 2W9
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: EVALUATION OF CONTROL AGENTS FOR CONTROL OF LEAFROLLER ATTACKING NORTH AMERICAN GINSENG IN MINERAL SOIL, 1998-99

MATERIALS: AMBUSH 500 EC (permethrin), POUNCE EC (permethrin), DIPEL DF (*Bacillus thuringiensis* subsp. *kurstaki*)

METHODS: Experiments investigating management of leafrollers were carried out each year in 0.12 ha ginseng gardens planted in October, 1995 (1998 trial) or October, 1996 (1999 trial) in Fox sandy loam on the Delhi Farm of the Southern Crop Protection and Food Research Centre (SCPFRC), and subsequently managed using commercially recommended practices. On June 8, 1998 and June 4, 1999 each control agent was applied at 1,350 kPa in 800 L/ha, to four beds (1.9 m x 44.4 m) using a Rittenhouse self propelled sprayer with a 3.2 m boom fitted with 6, TX18 hollow cone nozzles plus 1 drop-pipe behind each sprayer wheel with a TX18 nozzle directed into the foliage of each raised ginseng bed. Each year the remaining beds in the garden served as an untreated, CONTROL block. On June 11, 1998 and June 8, 1999 treatment effectiveness was determined by randomly collecting 4 samples of 10 rolled leaves from the centre 2 treatment beds for each control agent and from the untreated block. Rolled leaves were carefully opened and the number of empty rolled leaves and the numbers of living or dead leafrollers (LR) counted. Data were subjected to statistical analysis by ANOVA; significance of differences among treatments means was determined using an LSD Range Test.

RESIDUES: On August 5, 1998, plots 4.0 m long and separated from each other by 0.5 m buffer strips, were established down the length of 1 ginseng bed planted in October 1995 in Fox sandy loam on the Delhi Farm of the SCPFRC and subsequently managed using commercially recommended practices. On the same day, a second set of similar plots was established in a large commercial ginseng garden planted in the fall of 1996 in Lot 1, Concession 12 of the Gore of Norwich Township, Oxford County. At each site, both treatments were replicated 3x in a randomized complete block design. On August 14, 1998, AMBUSH 500EC was applied @ 400.0 ml/ha in 850 L/ha at 275 kPa using a hand-held, CO_2 pressurized R&D field-plot sprayer fitted with 4 - XR8004VS flat fan spray nozzles. On September 25, 1998, approximately 2 kg of ginseng roots were hand-dug from each plot at both sites. A subsample of 15 fresh roots was randomly selected from each sample and delivered to the laboratory of the Analytical Chemical Services Group of SCPFRC-London for determination of possible residues of permethrin using gas chromatography.

RESULTS: Please refer to Table 1 below. Each year, most collected larvae were in later instars and had reached a length of 1.5-2.5 cm. In 1998 several pupae were collected during assessment of insecticide effectiveness.

CONCLUSIONS: In both 1998 and 1999, significantly fewer living LR were found in rolled leaves from beds treated with permethrin than in rolled leaves from untreated beds or from beds treated with DIPEL. In 1999 fewer living LR were found in rolled leaves treated with DIPEL than in rolled leaves from untreated beds. In both years significantly more dead LR were counted in rolled leaves collected from beds treated with DIPEL. Also, each year, significantly more empty rolled leaves were collected from beds treated with permethrin. It is felt that LR leaving rolled leaves to feed, consumed a lethal dose of permethrin on treated foliage and fell from the plants before being able to return to the rolled leaf. Since the lethal effect of DIPEL is manifested more slowly, it is felt that many LR feeding on foliage treated with the bacterium were able to return to the rolled leaf before succumbing to the effects of the toxin. While application of both permethrin and DIPEL affected numbers of living LR in treated beds, in these trials, permethrin provided more effective and reliable control of the pest. Had LR-populations been detected and treated at an earlier stage of development, better control by DIPEL would likely have been recorded. According to label directions, DIPEL provides better control of early instar LR-larvae.

Residues: No permethrin was detected in any sample of fresh ginseng roots harvested 42 days after foliar application of the insecticide. The limit of detection for permethrin in these analyses was 0.005 ppm.

Table 1. Effect of control agents on the leafroller, *Archips purpurana*, attacking 3-year North American ginseng - 1998-99.

Tmt. No.	Insecticide Applied	Rate Applied (pdct./ha)	Mean Treatment Impact		
			# Alive	# Dead	# Empty Rolls[1]
1998:					
1	AMBUSH 500EC	400.0 ml	1.3 a[2]	0.0 a	8.8 b
2	DIPEL DF	2.0 kg	4.3 b	1.3 b	4.5 a
3	untreated	----	5.0 b	0.0 a	4.8 a
1999:					
1	POUNCE EC	520.0 ml	1.0 a	0.5 a	8.5 b
2	DIPEL DF	2.0 kg	3.3 b	4.0 b	2.8 a
3	untreated	----	6.5 c	0.0 a	3.5 a

[1] Number of rolled leaves that did not contain either a living or dead larva or pupa.

[2] Means within a column, and within each year, followed by the same letter are not significantly different (P• 0.05) as determined using an LSD means separation test.

1999 PMR REPORT # 50 SECTION B: INSECTS OF VEGETABLES AND SPECIALTY CROPS
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Cortland
PEST: Onion maggot (OM), (*Delia antiqua* Meigen)

NAME AND AGENCY:
HOEPTING C A[1], SCOTT-DUPREE C D[1] and MCDONALD M R[2]
[1] Dept; of Environmental Biology, University of Guelph
Guelph, Ontario N1G 2W1
Email: choeptin@uoguelph.ca; csdupree@evbhort.uoguelph.ca

[2] Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
R.R.#1 Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF INSECTICIDE AND FUNGICIDE TREATMENT COMBINATIONS FOR THE CONTROL OF ONION MAGGOT : FIELD TRIAL IN THE HOLLAND MARSH, 1999.

MATERIALS: LORSBAN G (chlorpyrifos 15%), GOVERNOR WP (cyromazine 75%), AZTEC G (phosetbupirin 2.0% + cyfluthrin 0.1%), REGENT WG (fipronil 80%), PRO GRO D (carbathiin 30% + thiram 50%), DITHANE DG (mancozeb 75%)

METHODS: The trial was conducted at the Muck Crops Research Station in the Holland Marsh with natural populations of onion flies and was arranged in a randomized complete block design with a total of 20 treatments and four replications. GOVERNOR 75WP, REGENT 80WG and PRO GRO 30/50D seed treatments were commercially film-coated at rates of 50, 25 and 20 g ai/kg of seed respectively by Bejozaden Ltd in Holland. LORSBAN 15G (4.8 kg ai/ha), AZTEC 2/0.1G (0.5 kg ai/ha) and DITHANE DG (6.6 kg ai/ha) were applied in-furrow at the time of planting. The trial was seeded at a rate of 47 seeds/m of row on May 4-6, using a push V-belt seeder. Each treatment plot consisted of four 6 m rows of onions spaced 40 cm apart. Four separate 2 m sections were randomly selected for each of three onion maggot damage assessments and final yield. To determine initial stand, emergence counts were taken on May 21, 25, 28 and Jun 2 in each 2 m section. OM damage was assessed at the end of each the first- (Jul 12), second- (Aug 17) and third- (Sep 22,23) generations as determined by monitoring onion fly trap catches and degree days. All onions in the 2 m sections of row were pulled and visually examined for maggot damage. Twice weekly from Jun 7 to Aug 12, dying onions were pulled and cause of death (OM, onion smut or other) was recorded. For yield assessment (Sep 15-17), weight and bulb size were taken from the remaining 2 m section of onions. Data were subjected to arcsin square root transformation prior to analysis using the General Analysis of Variance function of the Linear Models section of Statistix, V.4.1. Untransformed data are presented in the table. Interaction between insecticides (none, LORSBAN, GOVERNOR, AZTEC, REGENT) and fungicides (none, PRO GRO, DITHANE DG, PRO GRO+DITHANE DG) was analyzed using a 5 x 4 factorial design.

RESULTS: Significant differences were found among treatments for OM damage at all assessments (Table 1), but not for final yield (data not shown). No significant interaction between insecticides and fungicides was found at any assessment. There were no consistent significant differences or trends among insecticides across assessments or with fungicide combinations. Significant main effects showed that insecticide combinations with PRO GRO or PRO GRO + DITHANE DG reduced OM damage better than those with no fungicide(s) for all assessments. In 7 out of the 8 cases, fungicide treatments without any insecticide significantly reduced OM damage. When REGENT and AZTEC were used in combination with DITHANE DG, OM damage was significantly higher than when they were used in combination with PRO GRO + DITHANE DG in all and the last two assessments respectively. The air temperatures were above the long term (10 year) average (LTA) for June (25.3•C), July (28.4•C) and September (22.8•C) and below average for August (24.1•C). Total rainfall was below the LTA for June (68.5 mm), July (71 mm) and August (78.8 mm) and above the LTA for September (137.5 mm).

CONCLUSIONS: Efficacy of insecticide for control of OM varies depending on the selection of in-furrow fungicide(s). Best control of OM was achieved when insecticide was combined with PRO GRO + DITHANE DG. The nature of the identified interactions, whether they be chemical, physical or biological require further research, but it is important to consider them in order to optimize the control of OM.

Table 1. Percent onion maggot damage of onions treated with insecticides in combination with fungicides at the Muck Crops Research Station, Kettleby, Ontario, in 1999.

Treatment	Rate Applied	Onion Maggot Damage (%)		
		1st gen (12 Jul)	1st & 2nd gen (17 Aug)	1st, 2nd & 3rd gen (22,23 Sep)
untreated		21.2 a[2]	17.7 a	24.1 a
PG[1]	20 g ai/kg[3]	8.59 bc	4.01 cd	3.13 c-g
DG	6.6 kg ai/ha	13.4 ab	2.55 c-e	7.49 bc
PG+DG	20 g ai/kg + 6.6 kg ai/ha	2.67 b-e	4.28 c-e	3.46 c-f
L	4.8 kg ai/ha	4.51 b-d	6.99 bc	7.43 bc
PG+L	20 g ai/kg + 4.8 kg ai/ha	1.67 c-e	0.33 ef	4.81 c-f
DG+L	6.6 kg ai/ha + 4.8 kg ai/ha	2.79 b-e	0.60 ef	2.88 c-g
PG+DG+L	20 g ai/kg + 6.6 kg ai/ha + 4.8 kg ai/ha	0.00 e	0.59 ef	1.18 f-h
G	50 g ai/kg	2.07 b-e	4.58 cd	8.85 b
PG+G	20 g ai/kg + 50 g ai/kg	0.26 e	1.82 c-e	1.33 e-h
DG+G	6.6 kg ai/ha + 50 g ai/kg	0.31 e	0.00 f	1.74 d-h
PG+DG+G	20 g ai/kg + 6.6 kg ai/ha + 50 g ai/kg	0.60 c-e	0.40 ef	0.44 h
A	0.5 kg ai/ha	2.89 b-e	11.5 ab	8.76 b
PG+A	20 g ai/kg + 0.5 kg ai/ha	0.57 de	0.00 f	0.43 gh
DG+A	6.6 kg ai/ha + 0.5 kg ai/ha	0.74 de	2.62 c-e	5.13 b-e
PG+DG+A	20 g ai/kg + 6.6 kg ai/ha + 0.5 kg ai/ha	0.81 de	0.60 ef	1.67 e-h
R	25 g ai/kg	2.86 b-e	3.74 cd	5.27 b-d
PG+R	20 g ai/kg + 25 g ai/ha	0.00 e	0.30 ef	2.13 d-h
DG+R	6.6 kg ai/ha + 25 g ai/kg	4.82 b-d	2.07 de	4.75 b-e
PG+DG+R	20 g ai/kg + 6.6 kg ai/ha+ 25 g ai/kg	0.24 e	0.00 f	0.61 f-h

[1] **L**: LORSBAN, **G**: GOVERNOR, **A**: AZTEC, **R**: REGENT, **PG**: PRO GRO, **DG**:DITHANE DG

[2] Numbers in a column followed by the same letter are not significantly different at p=0.05, Fisher's Protected LSD test.

[3] Seed treatment : g ai/kg of seed.

1999 PMR REPORT # 51 SECTION B: INSECTS OF VEGETABLE AND SPECIAL CROPS

STUDY DATA BASE: 280-1252-9904

CROP: Summer Turnip, cv. Purple Top White Globe
PEST: Cabbage maggot (CM), *Delia radicum* (Linnaeus)

NAME AND AGENCY:
TOLMAN J H, BARR T R, McANINCH A L and McFADDEN G A
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: EVALUATION OF DRENCH TREATMENTS FOR CONTROL OF CABBAGE MAGGOT ATTACKING SUMMER TURNIP IN MINERAL SOIL, 1999

MATERIALS: CANON 200 SC (fipronil), ACTARA 25 WG (thiamethoxam), ADMIRE 240 F (imidacloprid), LORSBAN 4 E (chlorpyrifos)

METHODS: Summer turnip seed was planted on the London Research Farm of the Southern Crop Protection and Food Research Centre on May 13 in 1-row microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral soil. All treatments were replicated three times in a randomized complete block design. On June 21, to augment the native CM population, 10-15 CM eggs from an insecticide-susceptible, laboratory strain, originally collected near Chatham, ON, were buried 1 cm deep beside 10-12 of the largest roots (1 cm diameter) in each plot. To improve egg hatch and maggot survival, plots were watered after infestation. Infested plants were identified with a dated, plastic plant marker (1.5 cm x 12.5 cm). On June 25, drench insecticides were applied at 175 kPa in 20 L/100 m row in a 5-7 cm band over crown of developing plant, using a hand-held, CO_2-pressurized, single-nozzled (4006E flat fan) R&D plot sprayer. Beginning 1 hr after application, all plots subsequently received 25 mm water via sprinkler-irrigation to carry insecticides down into the soil where maggots were feeding. On July 12, all artificially infested turnips and 10 turnips damaged only by native CM were carefully pulled from each plot, washed and rated for CM feeding damage according to the rating scale developed by King and Forbes (1954) (See footnote, Table 1). Within each plot separate rating scores were developed for roots damaged by the augmented CM population and for turnips damaged only by wild CM. A Damage Index (D.I.) was then calculated for each group of turnips in each plot by multiplying the appropriate factor by the % of roots in each category, adding products and dividing the sum by 4. Statistical significance of observed impact of drench application on CM-injury was determined by analysis of variance. Significance of differences among treatments means was determined using a Least Significant Difference Test. Mean % Control of CM-damage by each drench treatment was calculated according to the formula: % Control = D.I.(Control) - D.I.(Tmt.)/D.I.(Control) x 100%

RESULTS/OBSERVATIONS: Results are presented in Table 1. No phytotoxicity was observed following any treatment.

CONCLUSIONS: When the native CM-population pressure was augmented by artificial infestation of

CM-eggs 4 days prior to drench application, no insecticide provided acceptable control of CM damage. Best control followed drench application of any rate of CANON; damage indices were significantly reduced by at least 35% relative to the D.I. recorded in untreated plots. Under augmented CM pressure, drench application of the commercial standard, LORSBAN reduced the D.I. by just over 20%. Neither neonicotinoid insecticide (ACTARA, ADMIRE) had a significant impact on the D.I. when CM pressure was increased. Heavy feeding damage was also recorded in untreated plots infested only by native CM. For native CM population pressure, all drench treatments except Tmt. 5 significantly reduced the D.I. in harvested turnips. With damage reductions of at least 80%, best control again followed drench application of any rate of CANON. If CM eggs were not infested around turnips in microplots, the D.I. in plots treated with LORSBAN were at least arithmetically, if not always statistically lower than the D.I.'s in plots treated with either ACTARA or ADMIRE. CANON thus appears a promising insecticide for protection of summer turnip from feeding damage by CM.

Table 1. Experimental drench treatments for control of cabbage maggot, *Delia radicum*, attacking summer turnip in mineral soil in microplots, London, ON, 1999.

Tmt. No.	Insecticide Applied	Rate Applied (pdct/ 100 m)	Treatment-Impact for Indicated Cabbage Maggot Population			
			Augmented[1] Population		Natural[2] Population	
			Dam. Index[3]	% Control[4]	Dam. Index	% Control
1	CANON 200SC	5.0 ml	47.9 c[5]	43.6	10.0 e	86.7
2	CANON 200SC	10.0 ml	45.5 c	46.5	11.7 de	84.4
3	CANON 200SC	15.0 ml	55.2 bc	35.1	15.0 de	80
4	ACTARA 25WG	6.0 g	85.0 a	0	47.4 b	36.8
5	ACTARA 25WG	8.0 g	84.4 a	0.7	58.3 ab	22.6
6	ACTARA 25WG	10.0 g	74.7 ab	12.1	45.0 bc	40
7	ADMIRE 240F	20.0 ml	72.0 abc	15.3	51.7 b	31.1
8	LORSBAN 4E	21.0 ml	66.4 abc	21.9	28.3 cd	62.3
9	untreated	---	85.0 a	---	75.0 a	---

[1] 10-15 cabbage maggot eggs buried around each turnip root 4 days prior to drench application of insecticides.

[2] Root injury solely due to feeding by maggots hatching from eggs deposited by native cabbage maggot flies

[3] Damage Index (D.I.) developed by King and Forbes (1954) where harvested roots rated for feeding damage according to the following scale: **clean** - factor of 0, no damage; **light** - factor of 1, slight, superficial early feeding but fully healed; **moderate** - factor of 2, marketable as Grade 2 after single trim just above tap root to remove single deep penetration or, moderate, healed surface injury affecting < 20% of surface that could be removed by peeling; **severe** - factor of 4, unmarketable for table use; injury not removable by practical trimming; any extensive unhealed surface injury; maggot in root. Damage Index was then calculated for each group of turnips in each plot by multiplying appropriate factor by the % of roots in each category, adding products and dividing sum by 4.

[4] Mean % Control relative to Damage Index (D.I.) for Untreated plots.
% Control = D.I.(Control) - D.I.(Tmt.)/D.I.(Control) x 100%

[5] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using a Least Significant Difference Range Test.

1999 PMR REPORT # 52 SECTION B: INSECTS OF VEGETABLE and SPECIAL CROPS
ICAR: 206003

CROP: Yellow cooking onions, cv. Hamlet
PEST: Onion maggot (OM) (*Delia antiqua* (Meigen)

NAME AND AGENCY:
MCDONALD M R, VANDER KOOI K AND JANSE S
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
1125 Woodchoppers Lane, RR#1 Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: **EVALUATION OF SPLIT APPLICATIONS OF LORSBAN 15 G AND LORSBAN 4 E FOR CONTROL OF ONION MAGGOT DAMAGE, 1999**

MATERIALS: LORSBAN 15 G (chloropyrifos 15%), LORSBAN 4 E (chloropyrifos 48%)

METHODS: Onions were direct seeded into organic soil (organic matter 60%, pH 6.4) on 26 April, at the Muck Crops Research Station where OM flies are naturally present. A randomized complete block arrangement with four replications per treatment was used. Each replicate consisted of two rows, 16 m in length. LORSBAN 15 G was applied in the furrow at seeding at 16 kg/ha or 8 kg/ha. On 31 May LORSBAN 4 E was applied at 2.5 L/ha as a drench over the rows of one of the 16kg/ha treatments and the 8 kg/ha treatment. An untreated check was also included. Four, 2 m sections were marked off for first generation assessment and two, 2 m sections were marked off for the second and third generations. Stand counts of each section were taken after emergence to determine an initial plant stand. Damage assessments began one week after first generation peak (18 June) of OM flies. On 10 July all the onions from the first generation were harvested and assessed. At the end of the second and third generations (20 August and 21 September respectively) all plants were harvested from the designated 2 m sections and assessed for damage. Harvest weights of onions in 2.33 m of row were taken on 21 September. The air temperatures were above the long term (10 year) average for June, July and September and below average for August. Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71 mm) and August (78.8 mm) and above average for September (137.5 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As outlined in Table 1.

CONCLUSIONS: Significant differences were found between the LORSBAN treatments and the control. The LORSBAN 15 G at 16 kg/ha + LORSBAN 4 E at 2.5 L/ha had the lowest percentage of OM damage in the first generation. First generation damage was high (20%) in the treated plots compared to the long term average (10 year) of first generation damage of 5.3%. No significant differences were observed in the second and third generations. While all LORSBAN treatments produced higher yield than the control, the differences was not statistically significant. The high level of damage in the treated plots may also reflect increasing resistance of the OM to LORSBAN.

Table 1. Impact of onion maggot at the Muck Crops Research Station, Bradford, Ontario, 1999.

Treatments	Rate Applied (product/ ha)	% OM - Damage for Indicated Generation			Yield T/ha[3]
		1st Generation	2nd Generation	3rd Generation	
Control	----	35.8 b[1]	12.0 NS[2]	21.1 NS[2]	47.9 NS[2]
LORSBAN 15 G	16 kg	14.9 a	17.2	8.3	59
LORSBAN 15 G + LORSBAN 4 E	16 kg + 2.5 L	13.7 a	20	20.3	50
LORSBAN 15 G + LORSBAN 4 E	8 kg +2.5 L	21.8 a	19	21.1	56.5

[1] Numbers in a column followed by the same letter are not significantly different at P = 0.05 Fisher's Protected LSD Test.

[2] NS = no significant treatment effects were observed.

[3] Bushels per Acre = T/ha x 17.8

END OF SECTION B (Pages 78-135; Reports # 38-52).

SECTION C POTATOES POMMES DE TERRE

REPORTS /RAPPORTS # 53 - 57

PAGES: 136 - 156

EDITOR **Dr. Jeff G. Stewart**

Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetetown, PEI C1A 7M8

Email: stewartj@em.agr.ca
Tel: (902) 566-6844
Fax: (902) 566-6821

1999 RAPPORT # 53 **SECTION C : INSECTES DES POMMES DE TERRE**
BASE DE DONNÉES DES ÉTUDES : 86000718

CULTURE: Pomme de terre, cv. Superior
RAVAGEUR: Doryphore de la pomme de terre, *Leptinotarsa decemlineata* (Say)

NOM ET ORGANISME:
BÉLANGER B et PAGÉ D
Institut de recherche et de développement en agroenvironnement, 2700, rue Einstein, Sainte-Foy, Québec, G1P 3W8
Tél. : (418) 643-3145 Télécopieur : (418) 644-6855 Email: bruno.belanger@irda.qc.ca

TITRE : EFFICACITÉ DU ACTARA APPLIQUÉ AU SOL ET SUR LE FEUILLAGE CONTRE LE DORYPHORE DE LA POMME DE TERRE, SAISON 1999

PRODUITS : ACTARA 25 WG (thiamethoxan 25%), ADMIRE 240F (imidacloprid 240 g/L)

MÉTHODES : L'essai a été réalisé à Deschambault (Québec) selon un plan à blocs complets aléatoires avec 4 répétitions. Les pommes de terre ont été plantées le 19 mai 1999 à 25 cm d'espacement. Les parcelles de 7,5 m de longueur comprenaient 4 rangs espacés de 0,9 m. Les traitements étaient les suivants: 1. ACTARA en bandes au sol à la plantation, 2. ACTARA en pulvérisations foliaires, 3. ADMIRE en pulvérisations foliaires et 4. TÉMOIN (sans traitement). Lors de la première intervention foliaire, la population larvaire était composée à 90% de larves de stade 1 et 2. Pour les traitements prévoyant des pulvérisations foliaires, celles-ci ont été faites le 26 juin et le 3 juillet à l'aide d'un pulvérisateur monté sur tracteur (pression: 690 kPa, volume: 400 L/ha). L'évaluation des densités du doryphore a été effectuée sur 10 plants pris au hasard dans les deux rangées du centre. Le dommage aux plants a été évalué visuellement à l'aide d'un indice de défoliation de 0 à 8. Pour éviter que les doryphores qui voulaient migrer des parcelles témoins vers les autres parcelles aient un impact sur la culture, un traitement foliaire au ADMIRE (200 ml p.c./ha) a été fait le 27 juillet sur l'ensemble des parcelles. Les plants de pommes de terre ont été défanés une première fois le 19 août avec du RÉGLONE (diquat 2,5 L p.c./ha) et le 26 août avec le même produit (diquat 1,5L p.c./ha). Le rendement en tubercules a été déterminé à partir de la récolte des deux rangées du centre de chaque parcelle faite le 7 septembre 1999.

RÉSULTATS: Voir le tableau ci-dessous.

CONCLUSION: L'efficacité de l'insecticide ACTARA a été comparée au ADMIRE. L'ensemble des résultats (populations larvaires, dommages et rendements) indiquent que le ACTARA s'est montré supérieur au ADMIRE à bien des égards. Le ACTARA appliqué au sol au moment de la plantation a permis de très bien contrôler les larves du doryphore, particulièrement au début de la saison. De plus, sur ces plants, aucun dommage causé par l'adulte de l'altise de la pomme de terre, *Epitrix cucumeris* (Harris), n'était visible, ce qui n'était pas le cas pour les autres traitements. D'ailleurs, ces plants avaient un développement végétatif plus important que les plants des autres parcelles. L'absence de dommage causé par le doryphore sur le feuillage est une autre indication de l'efficacité du ACTARA appliqué au sol. Toutefois, nous avons noté l'apparition de larves de doryphores au début juillet, nous laissant entrevoir une perte d'efficacité du produit. Le ACTARA appliqué sur le feuillage a également démontré une excellente efficacité. Comparé au ADMIRE, également appliqué sur le feuillage, l'insecticide ACTARA a permis de réduire d'une façon plus drastique le nombre de larves dès le premier traitement. L'utilisation du ACTARA, autant par traitement foliaire qu'au sol, nous a permis d'obtenir un rendement en pommes de terre supérieur à celui obtenu avec le ADMIRE.

Table 1. Nombre moyen de larves de doryphore/plant, dommage et rendement vendable, Deschambault, Qc, 1999.

Traitement Insecticide	Dose (p.c./ha)	Population larvaire				Dommage*				Rendement Vendable (t/ha)
		Juin		Juillet		Juin	Juillet			
		25	30	9	16	26	2	9	16	
ACTARA-sol	260 g	0,0b**	0,0d	0,4b	1.1b	0,0b	0,0c	0,0c	0,5b	54,3a
ACTARA-foliaire	104 g	52,9a	2,6c	0,1b	0,1c	1,0a	1,0b	0,0c	0,3b	53,7a
ADMIRE	200 ml	50,5a	5,5b	0,3b	0,5c	1,0a	1,0b	0,8b	0,5b	48,6b
TÉMOIN	---	48,7a	88,6a	25,5a	4,4a	1,0a	5,0a	7,0a	7,3a	7,0c

* Évaluation visuelle par parcelle : indice de défoliation (Indice "Boiteau" de 0 à 8 : (0) pas de défoliation; (1) 2-60% des plantes avec folioles légèrement endommagés; (1.5) > de 60% des plantes avec folioles légèrement endommagés; (2) 2% des plantes avec • une feuille composée défoliée à • 50%; (3) 2-9% des plantes avec • une tige défoliée à • 50%; (4) 10-24% des plantes avec • une tige défoliée à • 50%; (5) 25-49% des plantes avec • une tige défoliée à • 50%; (6) 50-74% des plantes avec • une tige défoliée à • 50%; (7) 75-99% des plantes avec • une tige défoliée à • 50%; (8) 100% des plantes avec • une tige défoliée à • 50%.

** Les résultats sans lettre ou suivis d'une même lettre ne sont pas significativement différents, à un seuil de 0,05 (Waller-Duncan).

1999 PMR Report # 54 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 303-1251-9601

CROP: Potato, cv. Superior
PEST: Colorado potato beetle, *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
STEWART J, SMITH M, AND MACDONALD, I
Agriculture and Agri-Food Canada, Crops and Livestock Research Centre
P.O. Box 1210, Charlottetown, PE C1A 7M8
Tel.: (902) 566-6844; FAX: (902) 566-6821, Email: stewartj@em.agr.ca

TITLE: MANAGEMENT OF THE COLORADO POTATO BEETLE ON POTATOES USING ACTARA, 1999

MATERIALS: ACTARA 25 WG (thiomethoxam), ADMIRE 240 FS (imidacloprid)

METHODS: Small, whole seed potatoes were planted at Harrington, PEI, on 20 May, 1999. Plants were established in four-row plots and spaced at about 0.4 m within rows and 0.9 m between rows. The plots, measuring 7.6 m in length and 3.7 m in width, were separated from each other by two buffer rows of potatoes. Plots were arranged in a randomized complete block design, with the following four treatments: 1) Not-treated Check; 2) foliar application of ACTARA 25 WG at 26 g AI/ha on 29 June 1999; 3) in-furrow application of ACTARA 25 WG at 65 g AI/ha at planting; and 4) foliar application of ADMIRE 240 F at 50 g AI/ha on 29 June 1999. Foliar applications were made using a CO_2-pressurized precision plot sprayer that delivered a final spray volume of 250 L H_2O/ha at 240 kPa. The in-furrow treatment was applied in a 15 cm band using a backpack sprayer that delivered a final spray volume of 1.6L/100 metres at 276 kPa. Counts of the numbers of Colorado potato beetle adults, early-instars (L1-L2), and late-instars (L3-L4) on 10 whole plants per plot were done at 1 day pre-spray (28 June) and 3, 7, 10, 14 21, 28, and 35 days post-spray. Percent defoliation in each plot was estimated each week throughout the growing season. After planting, plots received a pre-emergence application of metribuzin at 1.1 kg AI/ha for weed control. The buffer rows were sprayed with Furadan at 1.1 L prod/ha g AI/ha on 9 July, and with spinosyn A/D at 80 g AI/ha on 4 August and 20 August to prevent the inter-plot movement of insects. Throughout the summer, plots received recommended applications of chlorothalonil at 1.25 kg AI/ha for late blight control. Diquat was applied at the rate of 370 g AI/ha on 30 August for top desiccation. Tubers from the center two rows of each plot were harvested on 16 September and marketable (wt.>33 g) yields were recorded. Analyses of variance were performed on the data and Least Significant Differences (LSD) were calculated. Insect counts were transformed to Ln(x+1) before analysis. Percent defoliation was transformed to sqrt (arcsine(prop)) before analysis. Untransformed means are presented.

RESULTS: The seasonal average number of adults was significantly lower for the ACTARA and ADMIRE treatments than for the not-treated Check (Table 1). Based on seasonal averages, the foliar application of ACTARA and ADMIRE was more efficacious than the in-furrow application of ACTARA (Table 1). All products tested reduced L1-L2 and L3-L4 instars from July 2-19 (Tables 2 and 3). A foliar application of ACTARA or ADMIRE, or the in-furrow application of ACTARA, reduced defoliation by the Colorado potato beetle season-long relative to the Not-treated Check (Table 4). Marketable tuber yields (t/ha) were 31.2 for the Check, 44.2 for the foliar application of ACTARA, 43.1 for the in-furrow application of ACTARA, and 41.1 for the foliar application of ADMIRE. Tuber yields in plots protected with ACTARA or ADMIRE were statistically higher than the yields of the not-treated Check.

CONCLUSIONS: An in-furrow application of ACTARA at 65 g AI/ha, and foliar applications of ACTARA at 26 g AI/ha and ADMIRE at 50 g AI/ha reduced populations of the Colorado potato beetle relative to the not-treated Check.

Table 1. Efficacy of ACTARA and ADMIRE against Colorado potato beetle (CPB) adults, Harrington, PE, 1999.

Treatment	Rate g AI/ha	Mean No. CPB Adults/ Plant*					
		Jun. 22	Jun. 28	Aug. 3	Aug. 9	Aug. 23	Seas. Ave.
CHECK	-	0.5	0.3	7.2a	4.0a	1.4ab	1.6a
ACTARA 25 WG Foliar	26	0.3	0.2	0.6c	0.3b	0.1c	0.2c
ACTARA 25 WG In-furrow	65	0.1	0.1	3.1b	2.9b	1.6ab	0.9b
ADMIRE 240 FS Foliar	50	0.2	0.2	1.1c	1.1b	0.5bc	0.4c
ANOVA P• 0.05		ns	ns	s	s	s	s

* Numbers in a column followed by the same letter are not statistically different (P • 0.05, Protected Least Significant Differences Test).

Table 2. Efficacy of ACTARA and ADMIRE against Colorado potato beetle (CPB) larvae (L1-L2), Harrington, PE, 1999.

Treatment	Rate g AI/ha	Mean No. CPB L1-L2/ Plant*					
		Jun. 22	Jun. 28	July 2	July 12	Jul. 19	Seas. Ave.
CHECK	-	0.0	8.2a	11.5a	10.8a	3.5a	3.8a
ACTARA 25 WG Foliar	26	0.1	9.1a	1.9b	0.0b	0.3b	1.3b
ACTARA 25 WG In-furrow	65	0.0	0.0b	0.0b	0.5b	0.7b	0.6b
ADMIRE 240 FS Foliar	50	0.0	7.5a	1.5b	0.2b	0.2b	1.1b
ANOVA P• 0.05		s	s	s	s	s	s

* Numbers in a column followed by the same letter are not statistically different (P • 0.05, Protected Least Significant Differences Test).

Table 3. Efficacy of ACTARA and ADMIRE against Colorado potato beetle (CPB) larvae (L3-L4), Harrington, PE, 1999.

Treatment	Rate g AI/ha	Mean No. CPB L3-L4/ Plant*					
		July 2	July 5	July 9	July 12	July 19	Seas. Ave.
CHECK	-	5.1a	6.7a	13.4a	14.9a	10.2a	4.3a
ACTARA 25 WG Foliar	26	0.0b	0.0b	0.1b	0.1b	0.1b	0.2b
ACTARA 25 WG In-furrow	65	0.0b	0.0b	0.1b	0.3b	1.6b	0.3b
ADMIRE 240 FS Foliar	50	0.0b	0.0b	0.1b	0.1b	0.7b	0.2b
ANOVA P• 0.05		s	s	s	s	s	s

* Numbers in a column followed by the same letter are not statistically different (P • 0.05, Protected Least Significant Differences Test).

Table 4. Defoliation to potato plants protected with ACTARA and ADMIRE, Harrington, PE, 1999.

Trtmt	Rate g AI/ha	Defoliation (%)*					
		July 8	July 15	July 30	Aug. 13	Aug. 27	Seas. Ave.
CHECK	-	9.0a	20.3a	49.3a	62.0a	95.0a	52.1a
ACTARA 25 WG Foliar	26	0.2b	2.0b	2.8b	7.0b	20.5b	7.9b
ACTARA 25 WG In-furrow	65	0.2b	2.8b	2.4b	9.0b	25.5b	8.6b
ADMIRE 240 FS Foliar	50	0.1b	2.0b	2.8b	8.5b	21.5b	8.3b
ANOVA P• 0.05		s	s	s	s	s	s

* Numbers in a column followed by the same letter are not statistically different (P • 0.05, Protected Least Significant Differences Test).

1999 PMR Report # 55 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 303-1251-9601

CROP: Potato, cv. Superior
PEST: Colorado potato beetle, *Leptinotarsa decemlineata* (Say), potato flea beetle, *Epitrix cucumeris* (Harr.), aphids (Homoptera: Aphididae)

NAME AND AGENCY:
STEWART J, CHEVERIE R, MACDONALD, I, AND SMITH M
Agriculture and Agri-Food Canada, Crops and Livestock Research Centre
P.O. Box 1210, Charlottetown, PE C1A 7M8
Tel.: (902) 566-6844 FAX: (902) 566-6821 Email: stewartj@em.agr.ca

TITLE: **DOES THE pH OF THE SPRAY MIXTURE AFFECT THE EFFICACY OF ADMIRE AND MONITOR AGAINST INSECT PESTS ON POTATOES, 1999?**

MATERIALS: ADMIRE 240 F (imidacloprid), MONITOR 480 L (methamidophos)

METHODS: Small, whole-seed potatoes were planted in Harrington, PEI, on May 5, 1999. Plants were established in four-row plots and spaced at about 0.4 m within rows and 0.9 m between rows. The plots (48 in total), measuring 7.6 m in length and 3.7 m in width, were separated from each other by two buffer rows of potatoes. Plots were arranged in a split-split plot design, with insecticide product as the main effect, rate of application as the split effect, and pH level as the split-split effect. Products, rates of application, pH levels, and treatment dates are listed in Table 1. All insect counts and damage ratings were conducted each week from June 23 until August 10. The numbers of Colorado potato beetles (adults, egg masses, early-instars (L1-L2), and late-instars (L3-L4)), and potato flea beetles (adults and beetle-induced holes per fourth terminal leaf) were recorded from five plants per plot. Aphid (primarily potato, *Macrosiphum euphorbiae* (Thomas) and buckthorn, *Aphis nasturtii* Kaltenbach) population levels were estimated on fifteen compound leaves per plot. Defoliation by the Colorado potato beetle was assessed for each plot using a scale of 0-8 (0 = no damage, 1 = trace amounts, 2 = some defoliation, 3 = 0-9%, 4 = 10-24%, 5 = 25-49%, 6 = 50-74%, 7 = 75-99%, 8 = complete defoliation). Initially, insecticides were applied at a particular rate to all pH levels within that group whenever a threshold of 2 Colorado Potato Beetle Equivalents (CPBE) was reached or exceeded in any of the three pH levels tested. One CPBE = 1.0 spring adult, 0.125 L1-L2, 0.33 L3-L4, or 0.625 summer adults. Subsequent applications were made whenever the threshold was exceeded in a particular product-rate-pH combination (see Table 1 for dates). Foliar applications were made using a CO_2-pressurized precision plot sprayer that delivered a final spray volume of 250 L H_2O/ha at 240 kPa. After planting, plots received a pre-emergence application of metribuzin at 1.1 kg AI/ha for weed control. The buffer rows were sprayed with FURADAN at 580 g AI/ha on July 9, and with spinosyn A/D at 80 g AI/ha on August 6 to prevent the inter-plot movement of insects. Throughout the summer, plots received recommended applications of chlorothalonil at 1.25 kg AI/ha for late blight control. Diquat was applied at the rate of 370 g AI/ha on August 20 for top desiccation. Tubers from the center two rows of each plot were harvested on September 21, and marketable (wt.>33 g) yields were recorded. Analyses of variance were performed on the data and Least Significant Differences (LSD) were calculated. Insect counts were transformed to Ln(x+1) before analysis. Percent defoliation was transformed to sqrt (arcsine(prop)) before analysis. Untransformed means are presented.

RESULTS: The number of applications of ADMIRE or MONITOR varied from 1 to 5 depending on the rate of application and the pH of the spray mixture (Table 1). Within each rate of application, pH did not influence the efficacy of ADMIRE or MONITOR against Colorado potato beetle adults, larvae, CPBE, and their damage to plants (Tables 2 and 4). Similarly, no clear trends were evident with respect to the efficacy of these products against the potato flea beetle (adults and damage), aphids, or tuber yields (Tables 3 and 5).

CONCLUSIONS: Increasing the pH of spray mixtures from 6.0 to 7.8 did not affect the efficacy of ADMIRE at 24 or 48 g AI/ha or MONITOR at 0.54 or 1.08 kg AI/ha against the Colorado potato beetle, potato flea beetle, or aphids at Harrington, PEI, in 1999. Further trials are needed in 2000 to confirm this trend.

Table 1. List of products, rates of application, and pH levels of spray mixtures for the management of insect pests of potatoes, Harrington, PE, 1999.

Product	Rate (g AI/ha)	pH	Application Dates	Total Applications
ADMIRE	24	6.0	July, 3, July 29, Aug. 6	3
ADMIRE	24	7.0	July 3	1
ADMIRE	24	7.8	July 3, July 21	2
ADMIRE	48	6.0	June 25, July 29	2
ADMIRE	48	7.0	June 25, July 29	2
ADMIRE	48	7.8	June 25, July 29	2
MONITOR	540	6.0	July 3, July 14, July 29, Aug. 6	4
MONITOR	540	7.0	July 3. July 7, July 14, July 29, Aug. 6	5
MONITOR	540	7.8	July 3. July 7, July 14, July 21, July 29	5
MONITOR	1080	6.0	July 3, July 29	2
MONITOR	1080	7.0	July 3, July 14, July 21, July 29	4
MONITOR	1080	7.8	July 3, July 29	2

Table 2. Efficacy of ADMIRE, applied at three pH levels, against different growth stages of the Colorado potato beetle (CPB), Harrington, PE, 1999.

Product and Rate (g AI/ha)	pH	Mean No./ Plant/ Week*				% Defol./ Week
		Adults	L1-L2	L3-L4	CPBE	
ADMIRE-24	6.0	1.2	1.6	1.6	1.5	11.0
ADMIRE-24	7.0	0.9	2.1	1.7	1.4	16.7
ADMIRE-24	7.8	1.2	2.0	1.8	1.7	17.9
ANOVA P• 0.05		ns	ns	ns	ns	ns
ADMIRE-48	6.0	0.9	1.4	1.1	1.2	5.6
ADMIRE-48	7.0	1.0	2.5	2.1	1.7	9.2
ADMIRE-48	7.8	0.8	1.7	1.4	1.3	9.2
ANOVA P• 0.05		ns	ns	ns	ns	ns

* Within each rate of application, numbers within a column with the same letter are not significantly different (protected Least Significant Differences Test, P• 0.05).

Table 3. Efficacy of ADMIRE, applied at three pH levels, against potato flea beetle (PFB) adults and damage to fourth terminal leaves, aphids, and marketable tuber yields, Harrington, PE, 1999.

Product and Rate (g AI/ha)	pH	Mean No./ Plant/ Week*			Marketable Yield (t/ha)
		PFB Adults	Holes/ Leaf	Aphids	
ADMIRE-24	6.0	18.5	117.6	0.26	37.1
ADMIRE-24	7.0	8.9	123.2	0.40	33.7
ADMIRE-24	7.8	19.3	106.7	0.49	33.8
ANOVA P• 0.05		ns	ns	ns	ns
ADMIRE-48	6.0	11.7	100.7	0.31	42.6
ADMIRE-48	7.0	13.8	118.4	0.21	41.3
ADMIRE-48	7.8	12.3	115.9	0.11	37.9
ANOVA P• 0.05		ns	ns	ns	ns

* Within each rate of application, numbers within a column with the same letter are not significantly different (protected Least Significant Differences Test, P• 0.05).

Table 4. Efficacy of MONITOR, applied at three pH levels, against different growth stages of the Colorado potato beetle (CPB), Harrington, PE, 1999.

Product and Rate (g AI/ha)	pH	Mean No./ Plant/ Week*				% Defol./ Week
		Adults	L1-L2	L3-L4	CPBE	
MONITOR-540	6.0	0.9	3.7	3.1	2.1	16.3
MONITOR-540	7.0	1.1	2.6	3.2	2.1	15.9
MONITOR-540	7.8	1.0	3.5	3.3	2.2	20.7
ANOVA P• 0.05		ns	ns	ns	ns	ns
MONITOR-1080	6.0	1.0	1.8	2.3	1.6	16.8
MONITOR-1080	7.0	0.9	2.8	3.7	2.1	19.2
MONITOR-1080	7.8	0.7	2.6	2.9	1.7	20.7
ANOVA P• 0.05		ns	ns	ns	ns	ns

* Within each rate of application, numbers within a column with the same letter are not significantly different (protected Least Significant Differences Test, P• 0.05).

Table 5. Efficacy of ADMIRE, applied at three pH levels, against potato flea beetle (PFB) adults and damage to fourth terminal leaves, aphids, and marketable tuber yields, Harrington, PE, 1999.

Product and Rate (g AI/ha)	pH	Mean No./ Plant/ Week*			Marketable Yield (t/ha)
		PFB Adults	Holes/ Leaf	Aphids	
MONITOR-540	6.0	3.9	45.1	0.03	37.3
MONITOR-540	7.0	3.9	55.6	0.10	37.4
MONITOR-540	7.8	4.0	31.7	2.45	40.7
ANOVA P• 0.05		ns	ns	ns	ns
MONITOR-1080	6.0	5.3	82.0a	0.04	36.4
MONITOR-1080	7.0	4.3	62.3b	0.01	35.9
MONITOR-1080	7.8	6.9	89.6a	0.02	33.9
ANOVA P• 0.05		ns	s	ns	ns

* Within each rate of application, numbers within a column with the same letter are not significantly different (protected Least Significant Differences Test, P• 0.05).

1999 PMR REPORT # 56 SECTION C: POTATO INSECTS
STUDY DATA BASE: 280-1252-9904

CROP: Potato, cv. Superior
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
TOLMAN J H, BARR T A, and McANINCH A L
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997E-mail: tolmanj@em.agr.ca

TITLE: RELATIVE PERSISTENCE OF CONTROL AGENTS APPLIED TO POTATO FOLIAGE FOR CONTROL OF COLORADO POTATO BEETLE, 1999

MATERIALS: ADMIRE 240 F (imidacloprid), ACTARA 25 WG (thiamethoxam), DPX MP062 30 WG (indoxacarb), INCITE (piperonyl butoxide), EXP 61486A 70 WP (acetamiprid), AGRO 2000 (proprietary)

METHODS: Chitted seed potatoes were planted on the London Research Farm on May 11 in single-row (10 plants/row) microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free organic soil. All treatments were replicated three times in a randomized complete block design. On June 14 when plants were beginning to bud, 55 fully expanded compound leaves were tagged in each plot. Later on June 14, all treatments (Table 1) were applied at 250 kPa in 900 L/ha using a hand-held, CO_2-pressurized, single-nozzled (D-4-25 hollow cone) R&D plot sprayer. On June 28 when plants were in full flower, 55 compound leaves were tagged and foliar insecticides applied for a second time as described above. Residual effectiveness of foliar deposits against both adult and larval insecticide-susceptible, laboratory-reared CPB was measured by bioassay. As soon as spray deposits had dried on the foliage, a total of 6 tagged compound leaves were harvested from each plot of each treatment and returned to the laboratory for bioassay. Tagged compound leaves were thereafter collected at regular intervals for further bioassay (Tables 2-5). On each collection date a total of 9 adult-bioassays (3 bioassays/plot x 3 reps/tmt.), each containing 1 tri-foliate leaflet and 5 CPB adults, and 6 larval-bioassays (2 bioassays/plot x 3 reps/tmt.), each containing 2 x 3.55 cm leaf discs and 10 first instars, was established for each treatment. Bioassays were held at 25• C, 55% RH, and 16:8 L:D photoperiod. For each set of bioassays mortality and leaf damage were recorded after 72 hrs. Mortality was calculated using Abbott's correction and then subjected to arcsin square root transformation prior to statistical analysis by analysis of variance; Tukey's HSD Multiple Comparison test was used to estimate significance of differences among treatment means. Adult-damage reduction was determined by subtracting individual bioassay damage ratings from the average CONTROL damage rating and calculating % reduction. Areas of leaf discs remaining after 72 hrs were read directly using a LI-COR portable leaf area meter; larval damage reductions were calculated by subtracting leaf-areas consumed in individual treatment bioassays from the mean leaf area consumed in CONTROL bioassays and calculating % reduction.

RESULTS/OBSERVATIONS: After the first application on June 14, no rain fell during the 48 hrs after treatment. A total of 0.1 mm of rainfall subsequently accumulated by 5 days after treatment (DAT). Temperature reached 20.5• C on Day 0 (June 14); the average daily maximum temperature over the first

5 DAT was 19.0° C. After the second application on June 28, 4.1 mm rain fell during the 48 hrs after application. A total of 1.3 mm of rainfall subsequently accumulated by 5 DAT. Temperature reached 28.4° C on Day 0 (June 28); the average daily maximum temperature over the first 5 DAT was 26.2° C. No phytotoxicity was noted following any treatment.

In bioassay, in both trials, the neonicotinoid insecticides ADMIRE (Tmt. 1), ACTARA (Tmt. 2) and EXP 61486A (Tmt. 4) all provided more effective control of adult and larval CPB than did the tank-mix combination of DPX MP062 + INCITE (Tmt. 3)(Tables 2-5). Foliar application of AGRO 2000 (Tmt. 6) never effectively protected potato foliage from feeding damage by either adult or larval CPB (Tables 2-5). In the first trial, reduction of damage by adult CPB exceeded 80% for 7 days and 50% for 10 days after treatment (DAT) with either ACTARA or EXP 61486A (Table 2). In the same trial 80% damage-reduction persisted for 3 DAT with ADMIRE (Table 2). Also in the first trial, mortality of adult CPB equalled or exceed 80% for 7 DAT with ACTARA or EXP 61486A and for 3 DAT with ADMIRE (Table 2). Only on the day of application did mortality of adult CPB exceed 80% following application of DPX MP062 30WG + INCITE (Table 2). In the first trial, mortality of CPB larvae exceeded 80% for 3 DAT with all neonicotinoid insecticides (Table 3). Reduction of feeding damage by CPB larvae exceeded 80% for 7 DAT with EXP 61486A but only 3 DAT with ADMIRE or ACTARA (Table 3). DPX MP062 + INCITE reduced feeding damage by CPB larvae by at least 80% only on the day of application in this trial (Table 3). A shorter interval of control of both adult (cf. Tables 2 and 4) and larval CPB (cf. Tables 3 and 5) was observed following the second application of all neonicotinoid insecticides. The average maximum temperature during the 5 days following the second application was more than 6° C higher than temperatures recorded during the same period after the first trial. EXP 61486A appeared more affected than either ADMIRE or ACTARA by the weather conditions of the second trial. While adult mortality and damage reduction did not drop below 80% until 7 DAT with EXP 61486A in the first trial, similar control persisted only 1 DAT in the second trial (cf. Tables 2 and 4). Similar reductions were noted for control of CPB larvae (cf. Tables 3 and 5).

CONCLUSIONS: Based on the results of these experiments, the experimental neonicotinoid insecticides ACTARA and EXP 61486A, applied to potato foliage, provide control of both adult and larval CPB at least as good as that provided by ADMIRE, currently registered for use in Canada. Since application of the mixture of INCITE + DPX MP062 to potato foliage resulted in good protection of potato foliage from CPB larvae of the tested strain only on the day of application, the tested rates do not appear commercially viable. As tested, AGRO 2000 has no commercial future for CPB control.

Table 1. Experimental foliar treatments for control of Colorado potato beetle, *Leptinotarsa decemlineata*, attacking potato in field microplots, London, ON, 1999.

Tmt. No.	Insecticide(s)	Formulation	Rate Applied (product/ha)
1	imidacloprid	ADMIRE 240F	0.2 L
2	thiamethoxam	ACTARA 25WG	105.0 g
3	indoxacarb + piperonyl butoxide	DPX MP062 30WG + INCITE	115.0 g + 146 g
4	acetamiprid	EXP61486A 70WP	40.0 g
5	proprietary	AGRO 2000	9.0 L[1]
6	untreated	CONTROL	----

[1] AGRO 2000 applied to foliage at a concentration of 1% in 900 L spray carrier/ha.

Table 2. Effect of treated potato foliage on Colorado potato beetle (CPB) adults after feeding for 72 hours in bioassay - first foliar application, 14 June 1999.

Tmt No.	Treatment	Rate (pdct/ ha)	Adult CPB Response on Indicated Day after Treatment					
			Day 0		Day 1		Day 2	
			Mort.[1]	D.R.[2,3]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	97.4 b[4]	95.7 c	68.3 c	97.7 c	97.7 c	96.3 c
2	ACTARA 25WG	105.0 g	100.0 b	91.6 c	90.2 d	95.9 c	100.0 c	87.9 c
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	89.7 b	33.1 b	5.2 ab	41.4 b	30.3 b	34.3 b
4	EXP 61486A 70WP	40.0 g	87.2 b	96.7 c	79.9 cd	98.1 c	100.0 c	97.5 c
5	AGRO 2000	9.0 L	24.8 a	2.7 a	17.8 b	4.6 a	2.0 a	2.6 a
6	untreated	----	0.0 a	8.75	0.0 a	9.8	0.0 a	9.3

Tmt No.	Treatment	Rate (pdct/ ha)	Adult CPB Response on Indicated Day after Treatment					
			Day 3		Day 7		Day 10	
			Mort.[1]	D.R.[2,3]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	86.7 b	94.6 bc	42.2 b	47.1 a	4.4 ab	9.5 a
2	ACTARA 25WG	105.0 g	88.9 b	85.7 b	77.8 c	83.1 b	31.1 b	51.0 b
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	2.2 a	26.0 a	4.4 a	15.2 a	0.0 a	5.3 a
4	EXP 61486A 70WP	40.0 g	91.1 c	96.0 c	91.1 c	93.9 b	62.2 c	70.0 b
5	AGRO 2000	9.0 L	4.4 a	9.8 a	-[6]	--	--	--
6	untreated	--	0.0 a	9.3	0.0 a	9.1	0.0 a	9.3

[1] Corrected % adult mortality.

[2] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[3] Relative to feeding damage in leaves from untreated CONTROL plots (Tmt. 6).

[4] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[5] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

[6] Bioassay not done.

Table 3. Effect of treated potato foliage on Colorado potato beetle (CPB) larvae after feeding for 72 hours in bioassay - first foliar application, 14 June 1999.

Tmt No.	Treatment	Rate (pdct/ ha)	Larval CPB Response on Indicated Day after Treatment					
			Day 0		Day 1		Day 2	
			Mort.[1]	D.R.[2]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	100.0 b[3]	97.1 b	100.0 c	97.8 c	97.9 b	93.0 b
2	ACTARA 25WG	105.0 g	100.0 b	96.1 b	97.3 c	96.6 c	89.4 b	93.1 b
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	3.6 a	86.4 b	24.0 b	42.1 b	8.9 a	11.6 a
4	EXP 61486A 70WP	40.0 g	100.0 b	88.7 b	100.0 c	97.9 c	93.7 b	99.4 b
5	AGRO 2000	9.0 L	0.0 a	9.1 a	15.4 ab	8.3 a	-[5]	--
6	untreated	----	0.0 a	7.1[4]	0.0 a	6.8	0.0 a	5.8

Tmt No.	Treatment	Rate (pdct/ ha)	Larval CPB Response on Indicated Day after Treatment					
			Day 3		Day 7		Day 10	
			Mort.[1]	D.R.[2]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	100.0 c	88.8 b	31.6 ab	65.3 b	12.0 a	5.6 ab
2	ACTARA 25WG	105.0 g	90.6 c	85.5 b	47.6 b	72.2 b	2.7 a	37.7 b
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	17.3 b	0.6 a	6.6 ab	5.5 a	4.7 a	18.5 ab
4	EXP 61486A 70WP	40.0 g	98.3 c	87.7 b	50.0 b	89.8 b	17.1 a	6.6 ab
5	AGRO 2000	9.0 L	5.4 ab	0.0 a	--	--	--	--
6	untreated	----	0.0 a	6.3	0.0 a	7.5	0.0 a	6.3

[1] Corrected % larval mortality.

[2] % Damage Reduction relative to feeding damage in leaves from untreated CONTROL plots (Tmt. 6).

[3] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[4] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

[5] Bioassay not done.

Table 4. Effect of treated potato foliage on Colorado potato beetle (CPB) adults after feeding for 72 hours in bioassay - second foliar application, 28 June 1999.

Tmt No.	Treatment	Rate (pdct/ ha)	Adult CPB Response on Indicated Day after Treatment					
			Day 0		Day 1		Day 2	
			Mort.[1]	D.R.[2,3]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	100.0 c[4]	95.5 c	86.7 d	83.8 c	82.2 d	82.7 c
2	ACTARA 25WG	105.0 g	100.0 c	92.9 c	71.1 cd	67.5 c	76.1 cd	75.8 c
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	40.4 b	76.0 b	48.9 bc	18.1 b	25.8 ab	8.3 b
4	EXP 61486A 70WP	40.0 g	97.8 b	95.5 c	88.9 d	86.7 c	40.4 bc	78.7 c
5	AGRO 2000	9.0 L	0.0 a	1.3 a	17.8 ab	2.8 ab	11.0 ab	1.9 ab
6	untreated	----	0.0 a	9.45	0.0 a	8.7	0.0 a	9.6

Tmt No.	Treatment	Rate (pdct/ ha)	Adult CPB Response on Indicated Day after Treatment					
			Day 3		Day 7		Day 10	
			Mort.[1]	D.R.[2,3]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	78.9 c	66.9 bc	13.3 a	10.8 ab	6.1 a	2.9 a
2	ACTARA 25WG	105.0 g	91.7 c	86.3 c	57.8 b	47.4 c	46.2 b	41.8 c
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	15.7 ab	4.3 a	2.2 a	5.5 ab	6.1 a	7.9 ab
4	EXP 61486A 70WP	40.0 g	41.7 b	58.9 b	24.4 a	17.3 b	17.7 ab	20.8 bc
5	AGRO 2000	9.0 L	8.3 ab	5.5 a	-6	--	--	--
6	untreated	----	0.0 a	9.7	0.0 a	9.4	0.0 a	9.6

[1] Corrected % adult mortality.

[2] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[3] Relative to feeding damage in leaves from untreated CONTROL plots (Tmt. 6).

[4] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[5] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

[6] Bioassay not done.

Table 5. Effect of treated potato foliage on Colorado potato beetle (CPB) larvae after feeding for 72 hours in bioassay - second foliar application, 28 June 1999.

Tmt No.	Treatment	Rate (pdct/ ha)	Larval CPB Response on Indicated Day after Treatment					
			Day 0		Day 1		Day 2	
			Mort.[1]	D.R.[2]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	100.0 c[3]	100.0 b	88.3 c	84.8 b	65.0 b	85.6 b
2	ACTARA 25WG	105.0 g	98.3 c	100.0 b	91.7 c	84.1 b	75.0 a	93.5 b
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	58.3 b	94.6 b	56.7 b	62.4 a	16.7 a	58.3 a
4	EXP 61486A 70WP	40.0 g	100.0 c	100.0 b	73.0 c	87.2 b	55.0 b	72.6 b
5	AGRO 2000	9.0 L	100.0 c	39.2 a	15.0 ab	28.3 a	1.7 a	0.0 a
6	untreated	----	0.0 a	8.2[4]	0.0 a	8.3	0.0 a	8.9

Tmt No.	Treatment	Rate (pdct/ ha)	Larval CPB Response on Indicated Day after Treatment					
			Day 3		Day 7		Day 10	
			Mort.[1]	D.R.[2]	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	0.2 L	42.4 c	36.5 b	3.5 ab	20.7 b	0.0 a	0.0 a
2	ACTARA 25WG	105.0 g	65.9 c	80.7 c	14.6 b	24.8 b	0.0 a	0.0 a
3	DPX MP062 30WG + INCITE	115.0 g + 146 ml	28.8 b	20.5 b	3.5 ab	8.2 a	8.5 a	37.4 b
4	EXP 61486A 70WP	40.0 g	32.5 c	29.7 b	4.4 b	20.7 b	1.3 a	0.0 a
5	AGRO 2000	9.0 L	12.2 ab	29.6 b	-[5]	--	--	--
6	untreated	----	0.0 a	8.8	0.0 a	8.7	0.0 a	7.9 a

[1] Corrected % larval mortality.

[2] % Damage Reduction relative to feeding damage in leaves from untreated CONTROL plots (Tmt. 6).

[3] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[4] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

[5] Bioassay not done.

1999 PMR REPORT # 57 **SECTION C: POTATO INSECTS**
STUDY DATA BASE: 280-1252-9904

CROP: Potato, cv. Superior
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
TOLMAN J H, BARR T A, and McANINCH A L
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, Ontario N5V 4T3
Tel: (519) 457-1470 ext. 232 Fax: (519) 457-3997 E-mail: tolmanj@em.agr.ca

TITLE: **EVALUATION OF SEED-FURROW AND SOIL-DRENCH TREATMENTS FOR CONTROL OF COLORADO POTATO BEETLE ATTACKING POTATO, 1999**

MATERIALS: ADMIRE 240 F (imidacloprid), ACTARA 25 WG (thiamethoxam), AGRO 2000 (proprietary)

METHODS: Chitted seed potatoes were planted on the London Research Farm on May 11 in single-row (10 plants/row) microplots (2.25 m long x 0.9 m wide) filled with insecticide residue-free mineral (Tmts. 1-3, 5, 6) or organic (Tmt. 3) soil (Table 1). All treatments were replicated three times in a randomized complete block design. Seed-furrow treatments (Tmts. 1-3) were applied in a 5-7 cm band over seed pieces in the bottom of the planting furrow, using a hand-held, CO_2-pressurized, single-nozzled (6506 flat fan) R&D plot sprayer, at 200 kPa in 5 L water/100 m row. On June 7, soil-drench treatments (Tmts. 4-5) were applied to the soil and developing potato plants (15-20 cm tall) in a 15 cm band at 225 kPa in 20 L water/100 m row using the same sprayer fitted with an 8004EVS flat fan spray nozzle. On June 21, when plants were 35-45 cm tall, a second drench treatment was applied to the soil and lower 15 cm of developing potato plants at 250 kPa in 20 L water/100 m row using the same sprayer fitted with a 6506 flat fan spray nozzle. To supplement rainfall, microplots received 25 mm water via sprinkler-irrigation on May 19, June 11, 23, July 7, 13, and 27. Expanded compound leaves were regularly collected from each plot (Tables 2-4) and returned to the laboratory for bioassay. On each collection date a total of 9 adult-bioassays (3 bioassays/plot x 3 reps/tmt.), each containing 1 tri-foliate leaflet and 5 CPB adults, and 6 larval-bioassays (2 bioassays/plot x 3 reps/tmt.), each containing 2 x 3.55 cm leaf discs and 10 first instars, was established for each treatment. Bioassays were held at 25•±1•C, 55% ±5% RH, and 16:8 (L:D) photoperiod. For each set of bioassays mortality and leaf damage were recorded after 72 hrs. Mortality was calculated using Abbott's correction and then subjected to arcsin square root transformation prior to an analysis of variance. Tukey's HSD Multiple Comparison test was used to estimate significance of differences among treatment means. Adult-damage reduction was determined by subtracting individual bioassay damage ratings from the average CONTROL damage rating and calculating % reduction. Areas of leaf discs remaining after 72 hrs were read directly using a LI-COR portable leaf area meter; larval damage reductions were calculated by subtracting leaf-areas consumed in individual treatment bioassays from the mean leaf area consumed in CONTROL bioassays and calculating % reduction.

RESULTS/OBSERVATIONS: After the first soil-drench application on June 7, no rain fell during the 5 days after treatment (DAT). Temperature reached 31.6• C on Day 0; the average daily maximum temperature over the first 5 DAT was 30.7• C. After the second soil-drench application on June 21, no rain fell during the 48 hrs after application. A total of 4.3 mm of rainfall subsequently accumulated by 5 DAT. Temperature reached 27.1• C on Day 0. The average daily maximum temperature over the first 5 DAT was 29.4• C. No phytotoxicity was noted following any treatment.

In bioassay, foliage of potatoes treated in the seed furrow with ADMIRE (Tmt. 1) proved toxic to at least 70% of exposed CPB adults (Table 2) and larvae (Table 3) until at least 34 DAT. Damage reduction to foliage from the same treatment was reduced by at least 70% until 41 DAT (Tables 2, 3). Similar application of ACTARA at 4.0 g/100 m (Tmt. 2) resulted in at least 70% mortality of tested CPB adults and larvae until at least 48 DAT (Tables 2, 3). Larval damage to foliage collected from plants treated with the lower rate of ACTARA was also reduced by at least 70% until 48 DAT. With the exception of 41 DAT, foliage from potato plants treated with ACTARA at 6.0 g/100 m killed at least 70% of introduced CPB adults until 55 DAT (Table 2). Feeding damage by introduced adult CPB was also reduced by at least 70% until 55 DAT (Table 2). Foliage from plants treated with the higher rate of ACTARA killed at least 70% of introduced CPB larvae until 48 DAT. Larval feeding damage following seed-furrow application of ACTARA was cut by at least 70% until 62 DAT (Table 3). Mortality of CPB larvae, introduced onto foliage from plants treated with either rate of ACTARA, did not exceed 70% until the second bioassay, 34 DAT (Table 3). In spite of significant 72-hr survival in the first bioassay 28 DAT, larvae did not feed as no damage to leaf discs was observed (Table 3).

Soil-drench application of AGRO 2000 to either mineral or organic soil did not control either CPB adults (Table 4a) or larvae (Table 4b) on potato.

CONCLUSIONS: Application of either ADMIRE or ACTARA in the seed-furrow provided good to excellent early season control of both adult and larval CPB. Control by tested rates of ACTARA lasted longer than the tested rate of ADMIRE. For all seed-furrow treatments, corrected adult-mortality or adult-damage reduction occasionally exceeded 70% for bioassays established beyond 55 DAT (Tables 2). While more work is required to prove the hypothesis, we suspect that increased late-season insecticide effectiveness may follow resumed plant growth following irrigation or rainfall.

Table 1. Experimental seed-furrow and soil-treatments for control of Colorado potato beetle, *Leptinotarsa decemlineata*, attacking potato in field microplots, 1999.

Tmt. No.	Insecticide	Formulation	Method	Soil Type	Rate Applied (product/100 m)
1	imidacloprid	ADMIRE 240F	seed-furrow	mineral	10.0 ml
2	thiamethoxam	ACTARA 25WG	seed-furrow	mineral	4.0 g
3	thiamethoxam	ACTARA 25WG	seed-furrow	mineral	6.0 g
4	proprietary	AGRO 2000	soil-drench	organic	100.0 ml[1]
5	proprietary	AGRO 2000	soil-drench	mineral	100.0 ml
6	untreated	CONTROL	----	mineral	-----

[1] AGRO 2000 applied to soil and bottom 25 cm of potato plants at a concentration of 0.5% in 20 L spray carrier/100 m row.

Table 2. Effect of treated potato foliage on adult Colorado potato beetles (CPB) after feeding for 72 hours in bioassay, seed-furrow treatments, London, ON, 1999.

Tmt. No.	Treatment	Rate (pdct/ 100 m)	Adult CPB Response on Indicated Day after Treatment									
			Day 24		Day 28		Day 34		Day 41		Day 48	
			Mort.[1]	D.R.[2,3]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	10.0 ml	85.0 b[4]	81.6 b	95.2 b	95.6 b	76.9 b	94.8 b	50.0 b	78.2 b	60.0 b	65.4 b
2	ACTARA 25WG	4.0 g	91.5 b	81.6 b	100.0 b	93.2 b	97.4 b	81.0 b	75.6 c	82.9 bc	82.2 b	76.9 b
3	ACTARA 25WG	6.0 g	97.4 b	81.8 b	100.0 b	93.4 b	89.0 b	73.2 b	68.9 bc	87.4 c	91.1 b	80.8 b
6	Untreated	----	0.0 a	9.25	0.0 a	9.7	0.0 a	8.7	0.0 a	9.1	0.0 a	9.4

Tmt. No.	Treatment	Rate (pdct/ 100 m)	Adult CPB Response on Indicated Day after Treatment									
			Day 55		Day 62		Day 69		Day 76		Day 84	
			Mort.[1]	D.R.[2,3]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	10.0 ml	71.1 b	64.1 b	15.2 ab	31.6 b	10.0 ab	35.3 b	10.6 a	6.0 a	67.4 b	42.9 b
2	ACTARA 25WG	4.0 g	53.3 b	55.0 b	48.2 b	63.0 b	57.8 c	57.8 b	70.5 b	77.6 c	57.4 b	43.3 b
3	ACTARA 25WG	6.0 g	75.6 b	74.5 b	45.7 b	57.8 b	52.2 bc	59.5 b	59.9 b	42.4 b	72.6 b	69.4 b
6	Untreated	----	0.0 a	9.4	0.0 a	9.6	0.0 a	9.7	0.0 a	9.7	0.0 a	10

[1] Corrected % adult mortality.

[2] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[3] Relative to feeding damage in leaves from CONTROL plots (Tmt. 6).

[4] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[5] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

Table 3. Effect of treated potato foliage on Colorado potato beetle (CPB) larvae after feeding for 72 hours in bioassay, seed-furrow treatments, London, ON, 1999.

Tmt No.	Treatment	Rate (pdct/ 100 m)	Larval CPB Response on Indicated Day after Treatment									
			Day 28		Day 34		Day 41		Day 48		Day 55	
			Mort.[1]	D.R.[2]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	10.0 ml	85.0 b[3]	93.8 b	95.2 c	89.4 b	66.0 b	86.6 b	40.0 b	57.5 b	14.0 a	33.1 b
2	ACTARA 25WG	4.0 g	63.3 ab	100.0 b	81.1 bc	92.0 b	91.1 b	94.5 b	91.7 c	93.4 b	19.3 ab	69.0 c
3	ACTARA 25WG	6.0 g	53.3 ab	100.0 b	90.4 bc	94.9 b	83.9 b	95.3 b	90.0 c	97.5 b	61.4 b	80.4 c
6	Untreated	----	0.0 a	6.24	0.0 a	7.1	0.0 a	7.5	0.0 a	8.2	0.0 a	8.7

Tmt No.	Treatment	Rate (pdct/ 100 m)	Larval CPB Response on Indicated Day after Treatment									
			Day 62		Day 69		Day 76		Day 84		Day	
			Mort.[1]	D.R.[2]	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.	Mort.	D.R.
1	ADMIRE 240F	10.0 ml	0.0 a	1.0 a	1.7 ab	0.0 a	6.7 a	48.9 b	18.3 a	53.2 b		
2	ACTARA 25WG	4.0 g	1.7 a	35.6 b	1.7 ab	0.0 a	8.3 a	57.0 b	30.0 a	53.6 b		
3	ACTARA 25WG	6.0 g	43.3 b	76.6 c	11.7 b	0.0 a	3.3 a	3.3 a	10.0 a	42.3 b		
6	Untreated	----	0.0 a	8.2	0.0 a	4.4	0.0 a	8.9	0.0 a	8.4		

[1] Corrected % larval mortality.

[2] % Damage Reduction relative to feeding damage in leaves from untreated CONTROL plots (Tmt. 6).

[3] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[4] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

Table 4a. Effect of treated potato foliage on Colorado potato beetle (CPB) adults after feeding for 72 hours in bioassay, soil drench application, London, ON, 1999.

Tmt. No.	Treatment	Rate (pdct/ 100 m)	Soil Type	Adult CPB Response on Indicated Day after Treatment					
				Day 0-1[1]		Day 7-1[2]		Day 7-2[3]	
				Mort.[4]	D.R.[5,6]	Mort.	D.R.	Mort.	D.R.
4	AGRO 2000	100.0 ml	organic	5.6 a[7]	4.9 b	33.8 b	10.0 a	8.9 a	1.4 a
5	AGRO 2000	100.0 ml	mineral	6.4 a	1.7 a	23.1 ab	2.5 a	4.4 a	3.3 a
6	untreated	----	mineral	0.0 a	9.78	0.0 a	8.7	0.0 a	9.4

Table 4b. Effect of treated potato foliage on Colorado potato beetle (CPB) larvae after feeding for 72 hours in bioassay, soil drench application, London, ON, 1999.

Tmt. No.	Treatment	Rate (pdct/ 100 m)	Soil Type	Larval CPB Response on Indicated Day after Treatment					
				Day 0-1[1]		Day 7-1[2]		Day 7-2[3]	
				Mort.[4]	D.R.[6]	Mort.	D.R.	Mort.	D.R.
4	AGRO 2000	100.0 ml	organic	35.0 ab[7]	3.5 a	37.9 ab	5.1 a	8.3 ab	37.4 ab
5	AGRO 2000	100.0 ml	mineral	36.1 ab	4.7 a	4.7 a	20.7 a	9.9 ab	33.9 ab
6	untreated	----	mineral	0.0 a	6.7	0.0 a[9]	7.1	0.0 a	8.2

[1] 1 day after first soil-drench application.

[2] 7 days after first soil-drench application.

[3] 7 days after second and 14 days after first soil-drench applications.

[4] Corrected % mortality.

[5] % Damage Reduction: Actual leaf damage ratings used to develop "Damage Reductions" are available from principal author.

[6] Relative to feeding damage in leaves from untreated CONTROL plots (Tmt. 6).

[7] Means within a column followed by the same letter are not significantly different (P• 0.05) as determined using Tukey's HSD Multiple Comparison test.

[8] Actual 72-hour leaf damage rating (0-10 scale where 0.0 represents no feeding damage, 5.0 represents 50% loss of leaf area, 10.0 represents 100% consumption of the leaf).

[9] Actual area (cm^2) of leaf discs consumed in CONTROL bioassays during 72 hr feeding period.

END OF SECTION C (Pages 136-156; Reports # 53-57).

SECTION D - No reports in 1999.

SECTION E CEREALS, FORAGE CROPS AND OILSEEDS / CÉRÉALES, CULTURES FOURRAGÈRES ET OLÉAGINEUX

REPORTS /RAPPORTS # 58 - 59

PAGES: 157 - 162

EDITOR **Dr. Owen Olfert**
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, Saskatchewan S7N 0X2
Email: olferto@em.agr.ca
Tel: (306) 956-7288
Fax: (306) 956-7247

1999 PMR REPORT # 58 **SECTION E: CEREAL, FORAGE, AND OILSEED CROPS**
ICAR: 61006537

CROP: Beans: SO880 soybeans; Exrico 23 white beans; AC ELK kidney beans
PEST: Seed corn maggot, *Delia platura*

NAME AND AGENCY:
SCHAAFSMA A W
Ridgetown College of Agricultural Technology, University of Guelph, Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: CONTROL OF SEED CORN MAGGOT WITH SEED TREATMENTS

MATERIALS: VITAFLO 280 (thiram + carbathiin, 148 + 167 g ai/L); MAXIM 480 (fludioxinil, 480 g ai./L); APRON XL (metalaxyl-m, 369 g ai./L); AGROX DL PLUS (lindane + captan + diazinon, 33% + 33% + 33% w/w); ADAGE 600 (thiamethoxam 600 g ai./L); N002/99 WP (diazinon + captan, 11% + 33.5% w/w); GO1A3A & GO1A3B (LO176 + metalaxyl + vitavax + permethrin, 2 + 2 + 34 + 25 g ai./L); TI-435 600 FS (600 g ai./L).

METHODS: Seed was treated in 1 kg lots in individual plastic bags by applying the treatment or slurry (all treatments diluted to the same volume using water) via a syringe to each bag. The seed was then mixed for 1 minute to ensure thorough seed coverage. The crop was planted on 21 May, 1999 at Ridgetown using a 2-row cone seeder at 100 seeds per plot, except for the white beans which had 125 seeds per plot. Plots were 1 row planted at a row spacing of 0.76 m and 4 m in length placed in a randomized complete block design with 4 replications. Manure was placed on the plots 1 week prior to planting and the soil was worked shortly after the manure application. The plots were fertilized and maintained according to provincial recommendations. Total plot emergence was evaluated on 4 June, 1999. Seed corn maggot damage and number of maggots was also checked throughout a 1 m area in the centre of each plot. All seeds within the 1 m were counted, whether they had emerged or not and checked for seed corn maggot damage.

RESULTS: See Tables 1, 2 & 3.

CONCLUSIONS: For soybeans, only ADAGE at the high rate plus APRON XL and MAXIM improved emergence. However, the least amount of SCM damage occurred with AGROL DL PLUS.

All insecticides improved white bean emergence with the exception of GO1D2. The best emergence and least SCM injury was achieved with ADAGE at the higher rate.

NOO2/99 was the best candidate for SCM protection in kidney beans.

Table 1. Data showing emergence, seed corn maggot number/plant, and % plant damage in **soybeans** at Ridgetown, Ontario, 1999.

Treatment	Rate ml or g product /100 kg seed	Emergence # plants/plot 4-6-99	Maggots # /plant 4-6-99	Plants % Damaged
UNTREATED		63.5	0.05	26
N002/99 WP	320	62.3	0	16
APRON XL +MAXIM +INSECTICIDE	10.2 5.2 0	63.8	0.02	29
APRON XL +MAXIM +ADAGE 600	10.2 5.2 50	75	0	21
APRON XL +MAXIM +ADAGE 600	10.2 5.2 83	76.8	0.01	21
APRON XL +MAXIM +AGROX DL (dust)	10.2 5.2 200	71.3	0	9
GO1A3	300	58.3	0	23
GO1A3A (slurry) +GO1A3B (dust)	300242	72	0.04	16
TI-435 600 FS +VITAFLO 280	200 280	71.8	0	16
TI-435 600 FS +VITAFLO 280	400280	72.3	0	19
TI-435 600 FS +VITAFLO 280	600 280	73	0	19
TI-435 600 FS +VITAFLO 280	800200	71.8	0.01	17
LSD (P=.05)		12.01	0.04	14.6
CV		12.01	251.92	52.9

Table 2. Data showing emergence, seed corn maggot number/plant, and % plants damaged in **white beans** at Ridgetown, Ontario, 1999

Treatment	Rate ml or g product /100 kg seed	Emergence # plants/plot 4-6-99	Maggots # /plant 4-6-99	Plants % Damaged
UNTREATED		44.5	0.07	37
N002/99 WP	320	61.5	0.02	22
APRON XL +MAXIM +INSECTICIDE	10.2 5.2 0	59.5	0.04	36
APRON XL +MAXIM +ADAGE 600	10.2 5.2 50	67.8	0	36
APRON XL + MAXIM + ADAGE 600	10.2 5.2 83	71	0	18
APRON XL +MAXIM +AGROX DL (dust)	10.2 5.2 200	60	0	29
GO1A3	300	55	0.13	37
GO1A3A (slurry) +GO1A3B (dust)	300242	63	0.06	33
TI-435 600 FS +VITAFLO 280	200 280	60.8	0	32
TI-435 600 FS +VITAFLO 280	400280	62.8	0	22
TI-435 600 FS +VITAFLO 280	600 280	65.5	0.02	41
TI-435 600 FS +VITAFLO 280	800 200	60.5	0	14
LSD (P=.05)		14.9	0.09	25.8
CV		16.9	209.9	60.4

Table 3: Data showing emergence, seed corn maggot number/plant, and % plants damaged in **kidney beans** at Ridgetown, Ontario, 1999.

Treatment	Rate ml or g product /100 kg seed	Emergence # plants/plot 4-6-99	Maggots # /plant 4-6-99	Plants % Damaged
UNTREATED		54.5	0.07	27
N002/99 WP	320	69.5	0	9
APRON XL +MAXIM +INSECTICIDE	10.2 5.2 0	58.5	0.02	33
APRON XL +MAXIM +ADAGE 600	10.2 5.2 50	68.8	0	28
APRON XL + MAXIM +ADAGE 600	10.2 5.2 83	64.5	0	13
APRON XL +MAXIM +AGROX DL (dust)	10.2 5.2 200	55.5	0.02	49
GO1A3	300	54	0.12	45
GO1A3A (slurry) +GO1A3B (dust)	300242	66.5	0.07	35
TI-435 600 FS +VITAFLO 280	200 280	61.5	0	27
TI-435 600 FS +VITAFLO 280	400 280	63.8	0	18
TI-435 600 FS +VITAFLO 280	600 280	60.8	0	33
TI-435 600 FS +VITAFLO 280	800 200	55.5	0	49
LSD (P=.05)		11.2	0.07	18.1
CV		12.7	187.04	41.2

1999 PRM REPORT # 59 **SECTION E: CEREAL, FORAGE, AND OILSEED CROPS**

CROP: Corn (*Zea maize* L.), hybrid 38W36
PEST: Wireworm, Elateridae, sp unknown

NAME AND AGENCY:
SCHAAFSMA A W
Ridgetown College, University of Guelph, Ridgetown, Ontario N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email:aschaafs@ridgetownc.uoguelph.ca

TITLE: CONTROL OF WIREWORM IN FIELD CORN WITH SEED TREATMENTS

MATERIALS: APRON XL (metalaxyl-m, 369 g ai/L); MAXIM 480 FS (fludioxinil, 480 ai.g/L); ADAGE 600 (thiamethoxam 600 g ai./L); AGROX DL PLUS (lindane + captan + diazinon, 33% + 33% +33% w/w); N001/99 WP (diazinon + captan, 15% + 15% w/w); N003/99 WP (diazinon + captan, 15% + 30% w/w); GO1B2 (LS176 + metalaxyl, 2 + 2 g ai/L); GO1B3 (LS176 + metalaxyl + imidacloprid, 2 + 2 + 50 g ai/L); GO1B4 (LS176 + metalaxyl + imidacloprid, 2 + 2+ 25 g ai/L); GO1B5 (LS176 + metalaxyl + imidacloprid, 2 + 2 + 10 g ai/L).

METHODS: Seed was treated in 1 kg lots in individual plastic bags by applying the treatment via a syringe to each bag. The seed was then mixed for 1 minute to ensure thorough seed coverage. The crop was planted on 27 May, 1999 at a Ridgetown location using a 2 row planter at 80 seeds per plot. Plots were 1 row planted at a row spacing of 0.76 m and 10 m in length placed in randomized complete block design with 4 replications. The plots were fertilized and maintained according to provincial recommendations. Total plot emergence was evaluated at the 3-4 leaf stage on 7 June, 1999 and a final plot stand determined at the pre-tassel stage on 9 July, 1999.

RESULTS: See Table 1.

CONCLUSIONS: Using APRON XL and MAXIM as the fungicide control, GO1B3, GO1B4 and ADAGE at the high rate improved emergence in the presence of wireworm.

Table 1. Emergence of field corn with seed treatments for wireworm control at Ridgetown, 1999.

Treatment	Rate ml or g/100kg seed	Emergence/10 m plot 3-4 leaf stage 6-7-99	Emergence/ 10 m plot pre-tassel stage 7-9-99
Check		44.3	42.3
GO1B2	300	56.8	49.5
GO1B3	300	65.8	60.3
GO1B4	300	67	60
GO1B5	300	64.8	57.8
N001/99	200	52.5	48.5
N003/99	210	61.8	49.8
Apron XL +Maxim	10.2 5.2	53.8	51.3
Apron XL +Maxim +Adage 600	10.2 5.2 50	60	56.8
Apron XL +Maxim +Adage 600	10.2 5.2 83	65.8	58.5
Apron XL +Maxim +Agrox DL (dust)	10.2 5.2 200	64.3	60.8
LSD (P=.05)		11.4	13.7
CV		13.3	17.6

END OF SECTION E (Pages 157-162; Reports # 58-59)

SECTION F: No reports in 1999.

SECTION G BASIC STUDIES (ENTOMOLOGY) ÉTUDES DE BASE (ENTOMOLOGIE)

REPORTS /RAPPORTS # 60 - 61

PAGES: 163 - 166

EDITOR **Mrs. Stephanie Hilton**

Agriculture and Agri-Food Canada
Southern Crop Protection and Food
Research Centre, 1391 Sandford St.
London, Ontario N5V 4T3

Email: hiltons@em.agr.ca
Tel: (519) 457-1470 ext. 218
Fax: (519) 457-3997

1999 PMR REPORT # 60 **SECTION G: BASIC STUDIES (INSECT PESTS)**
STUDY DATA BASE: 9207

CROP: Fruit bins
PEST: Codling moth, *Cydia pomonella* (Linnaeus)

NAME and AGENCY:
SHOLBERG P, COSSENTINE J, HAAG P, LASHUK L, SHEPHARD T AND JENSEN L
Agriculture and Agri-food Canada, Pacific Agri-Food Research Centre, Summerland, B.C. V0H 1Z0
Tel:250-494-7711 Fax:250-494-0755
E-mail: SHOLBERG@EM.AGR.CA, COSSENTINEJ@EM.AGR.CA

TITLE: LABORATORY FUMIGATION OF CODLING MOTH LARVAE

MATERIALS: Formic acid and glacial acetic acid

METHODS: Late instar codling moth larvae were obtained from the colony of the Okanagan-Kootenay Sterile Insect Release Program (Osoyoos, BC). A single larva was placed in a superficial groove in a small (approximately 1.5 x 2.5 x 3.5 cm^3) block of rough-cut spruce wood (to simulate a fruit bin). Each larva was held in place using two small rectangles of plastic screen secured with elastic bands. The wrapped larvae were left to form a silk hibernaculum for up to 24 hours before the outside layer of screen was removed and the larvae were treated.

A group of 48 to 58 larvae in wooden blocks were placed inside a small fumigation chamber (23 L volume). Five ml of 80% formic or glacial acetic acid were introduced at time zero and an additional two ml of formic acid or five ml of acetic acid were added after two hours. Five ml of water was introduced at time zero in the control tests. The fumigation chamber was vented after five hours of fumigation and the larvae were incubated within the wood blocks at 22°C. Mortality was assessed 24 to 48 hours post treatment.

Each treatment was replicated four times over days. The percent mortality was modified using an arcsine transformation before analysis of the data (ANOVA).

RESULTS: Both fumigants caused significantly ($P<0.05$) higher codling moth mortality than the control

(Table 1).

CONCLUSION: Fumigation, using formic acid or acetic acid, of late instar codling moth larvae causes high mortality of the insect. This technology may be suitable to control codling moth larvae diapausing within wooden fruit bins

Table 1. Mean mortality of late instar codling moth larvae after fumigation with formic or acetic acid.

Treatment	Mean percent mortality	(sd)	P<F
formic acid	96.06	-2.78	0.0005
control	0.98	-1.14	
acetic acid	89.89	-13.05	0.0097
control	0	0	

1999 PMR REPORT # 61 **SECTION G: BASIC STUDIES**
STUDY BASE NUMBER: 280-1252-9913

CR0P: Potato
PEST: Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say)

NAME AND AGENCY:
HILTON S A, TOLMAN J H, and MACARTHUR D C
Agriculture and Agri-Food Canada, Southern Crop Protection and Food Research Centre
1391 Sandford Street, London, ON, Canada N5V 4T3
Tel: (519) 457-1470 Fax: (519) 457-3397 Email: hiltons@em.agr.ca

TITLE: SUSCEPTIBILITY TO IMIDACLOPRID AND OTHER INSECTICIDES OF FIELD-COLLECTED COLORADO POTATO BEETLES FROM ACROSS CANADA IN BIOASSAY, 1999

MATERIALS: Technical (>95% purity) imidacloprid, chlorfenapyr, fipronil, cypermethrin, azinphosmethyl, endosulfan

METHODS: In a Potter spray tower, 5 ml of technical (>95% purity) insecticide in 19:1 acetone:olive oil was sprayed directly onto 4 replicates of 10 adult CPB collected from field populations from four provinces. Four concentrations were selected to kill from 10 to 90% of the treated insects. Results were compared to the standard, insecticide-susceptible, lab-reared strain (Lab-S). The Standard Tolerance Ratio (STR) (LC_{50} subject population/LC_{50} standard lab strain) compared the susceptibility to imidacloprid of each field strain to the susceptibility of the laboratory culture. The Field Tolerance Ratio (FTR) (LC_{50} subject population/LC_{50} most susceptible population) provided an index of the total variation in susceptibility to imidacloprid among all tested populations. The results were compared to those obtained during the previous three years; the number of subject field populations tested (n) were not the same in different years nor for different compounds (Table 1).

RESULTS: In direct contact bioassays in 1999, the ratio of the LC_{50} for imidacloprid of the most tolerant strain to that of the Lab-S strain was 2.7x at 1 day after treatment (DAT) and 4.6x at 8 DAT (Table 2). The LC_{50} of imidacloprid of the Lab-S strain was 0.00022 % solution at 1 DAT and increased to 0.00054 % at 8 DAT. This increase in LC_{50} of imidacloprid observed 8 DAT continues the observed pattern of adult recovery from intoxication after exposure to the insecticide. At 8 DAT, 21 out of 29 field populations tested were slightly more tolerant to imidacloprid than the Lab-S strain. Of the 8 more susceptible populations, one outlier strain was more than 2x more susceptible than the lab strain. Calculation of the FTR using the most susceptible population produced ratios for imidacloprid of 6.0x at 1 DAT and 13.0x at 8 DAT (Table 2 - in brackets). The differences in susceptibility among field populations likely reflected natural variability among populations and difference in ages of collected adults. For the other five tested insecticides, the laboratory CPB strain was the most susceptible. The STR for chlorfenapyr was 5.1x and 31.3x for fipronil. Results for susceptibility of the Lab-S strain to fipronil were unique in that the LC_{50} was much less than all of the field populations in both adult direct contact bioassays and 2nd instar leaf dip bioassays. The maximum tolerance ratio among field populations (adults) for fipronil was 9.6x. Comparisons of maximum STR's for 1997-1999 did not indicate any major change in tolerance to cypermethrin, azinphosmethyl and endosulfan for any of the collected CPB populations during the study period.

CONCLUSIONS: There was no resistance detected to imidacloprid, fipronil or chlorfenapyr. Resistance to cypermethrin, azinphosmethyl and endosulfan appeared to have stabilized in the absence of selection pressure.

Table 1. Number of field populations of adults tested in direct contact bioassays for each insecticide in each year.

Insecticide	Number of field populations tested			
	1996	1997	1998	1999
imidacloprid	14	14	28	28
chlorfenapyr	8	10	26	20
fipronil	-	8	7	23
cypermethrin	9	8	8	8
azinphosmethyl	6	8	9	4
endosulfan	7	7	8	4

Table 2. Dose response of populations of CPB to selected insecticides applied by direct contact in bioassay, 1999.

Insecticide	DAT	Susceptibility Range - 1999 LC_{50} (% Solution)	Maximum Standard Tolerance Ratio[1]			
			1996	1997	1998	1999
imidacloprid	1	0.0001 - 0.0006	4.4 (14.0)[2]	4.5 (10.0)	1.6 (4.0)	2.7 (6.0)
	8	0.00019 - 0.0025	-	6.0 (23.1)	2.2 (10.7)	4.6 (13.0)
chlorfenapyr	3	0.0072 - 0.037	3	4.1	7.7	5.1
fipronil	3	0.00016 - 0.005	-	25	8.5	31.3 [9.6][3]
cypermethrin	2	0.0022 - >.1	64	28	34.2	>45.0
azinphosmethyl	1	0.035 - 0.38	30	12	4.6	10.9
endosulfan	1	0.007 - >1.0	166	111.1	>100.0	>100.0

[1] Ratio of LC_{50} of subject CPB population/LC_{50} of the standard susceptible Lab-S strain; for conventional insecticides, this represents the resistance ratio.

[2] Field Tolerance Ratio (FTR) (in brackets) = LC_{50} of subject CPB population/LC_{50} of most susceptible CPB population.

[3] Ratio of LC_{50} most tolerant subject population/LC_{50} of the least tolerant field population.

END OF SECTION G (Pages 163-166; Reports 60-61).

SECTION H	**PEST MANAGEMENT METHODS**	**MÉTHODES DE LUTTE DIRIGÉE**
Ha - no reports	Biological Control - Weeds	Lutte biologiques - mauvaises herbes
Hb - 1 report	Biological Control - Insects, Mites, Nematodes	Lutte biologiques - insectes, acariens, nématodes
Hc	Semiochemicals - Insect Pheromones and Natural Products	Sémiochimiques - Phéromones des insectes et prodruits naturelles

REPORTS /RAPPORTS # 62 - 63 **See related report # 6 (p 14) on beneficial nematodes.**

PAGES: 167 - 170

EDITOR **Dr. R.M. Trimble**

Agriculture and Agri-Food Canada
Southern Crop Protection and Food
Research Centre, 4902 Victoria Ave.
N.
P.O. Box 6000
Vineland Station, Ontario L0R 2E0

Email: trimbler@em.agr.ca
Tel: (905) 562-4113
Fax: (905) 562-4335

1999 PMR REPORT # 62 **SECTION Hc:SEMIOCHEMICALS**
STUDY BASE NUMBER: 306-1262-9020

CROP: Lowbush blueberry
PEST: Blueberry maggot adult (BM), *Rhagoletis mendax* Curran(L.).

NAME AND AGENCY:
GAUL S O, MACKENZIE K A
Agriculture and Agri-Food Canada, Atlantic Food and Horticulture Research Centre, 32 Main St., Kentville, Nova Scotia, B4N 1J5
Tel: (902) 679-5333 Fax: (902) 679-2311 Email: gauls@em.agr.ca

TITLE: EFFICACY OF IPM TECHNOLOGIES TRAP COMPARED WITH CONVENTIONAL BAITED PHEROCON TRAP

MATERIALS: IPM Technologies traps; Pherocon AM ammonium baited traps (conventional).

METHODS: The experiment was conducted on 4 commercial lowbush blueberry fields (4-10 ha each) in Colchester, Cumberland and Hants Co. N.S. Traps (14/site) grouped by trap type, spaced at distances from 2.5 m to 10 m, with the groups separated by 50 m and the direction of spacing randomized by field in a factorial design, were set out June 28-30, 1999. Adult *R. mendax* captures were monitored three times weekly from June 28 to August 14, 1999. The traps were replaced after 3 weeks. Trap capture counts were analyzed (following square root transformation) using ANOVA and the traps were compared to determine the relative efficacy to capture male, female, and total *R. mendax* in fruiting fields. The estimated standard error of the counts (Ese) was calculated.

RESULTS: There was no difference in captures of adult *R. mendax* in commercial lowbush blueberry fields ($p<0.05$) demonstrated due to trap type in this experiment.

CONCLUSIONS: The conventional baited Pherocon trap captured more total adult *R. mendax* compared with the IPM Technologies trap; however, both traps were effective in capturing adult *R. mendax* in commercial lowbush blueberry fields.

Table 1. Total seasonal adult *R. mendax* captures/trap (sem) on traps set in commercial lowbush blueberry fields in Nova Scotia in 1999.

Treatment	*R. mendax* adult captures (#)		
	Males	Females	Total
Conventional baited Pherocon trap	1.7	2	4.97
IPM Technologies trap	2.2	1.9	5.57
Ese	0.082	0.133	0.173

1999 PMR REPORT # 63 **SECTION Hc:SEMIOCHEMICALS**
STUDY BASE NUMBER: 306-1262-9020

CROP: Apple
PEST: Codling Moth, *Cydia pomonella*

NAME AND AGENCY:
PHILIP HG, HEDGES, W
BC Ministry of Agriculture & Food
200- 1690 Powick Road, Kelowna BC V1X 7G5
Tel: (250) 861-7230 Fax: (250) 861-7490 Email:hugh.philip@gems8.gov.bc.ca
and
FISHER-FLEMING, B
BC Fruit Packers Cooperative
880 Vaughan Ave
Kelowna BC
V1Y 7E4
Tel: (250) 762-7003 Fax: (250) 763-7370 Email: bfisherf@bctree.com

TITLE: COMPARISON OF TWO SEX PHEROMONE LURES FOR SEASONAL MONITORING OF MALE CODLING MOTHS

MATERIALS: Standard red septa lure loaded with 1mg codling moth sex pheromone (Phero Tech Inc.); Flexlure loaded codling moth sex pheromone (load unknown) (Phero Tech Inc.); wing traps.

METHODS: Thirty wing traps each baited with a single standard codling moth lure were each set out in an apple block near Kelowna on May 3/99. The lures were replaced June 1, July 5, August 2 and September 6. A wing trap baited with a single Flexlure was placed in the same blocks on May 3, and lures were replaced only once (July 5) in 15 of the traps. Some of the blocks had additional traps baited with the standard lure in order to achieve a trapping density of one trap/ha. All traps were checked weekly, codling moth captures recorded, and the sticky trap bottoms replaced as necessary to maintain optimum performance of the traps.

RESULTS: Figure 1 shows the average number of male codling moths captured per week in traps baited with standard lures (replaced four times) and with Flexlures that were not changed throughout the season. The pattern and number of codling moth captures are very similar for both lure types over the entire trapping period. The range of average weekly moth captures for the Flexlure-baited traps was 0-3.5, with a mean for the season of 1.0. Comparable values for the standard lure-baited traps were 0-4.5, mean 0.85. Figure 2 shows the average number of male codling moths captured per week in traps baited with standard lures (replaced four times) and with Flexlures that were changed midway through the season (to correspond with second brood moths). Again there was little difference between the two lure types in the pattern of codling moth male activity throughout the season, however the Flexlure-baited traps captured about 60% more moths over the season. The range of average weekly moth captures for the Flexlure-baited traps was 0.2-9.4, with a mean for the season of 3.5. Comparable values for the standard lure-baited traps were 0.13-5.75, mean 2.2 moths/trap/week.

CONCLUSIONS: A single Flexlure is capable of monitoring male codling moths with the same efficiency as the standard pheromone lure replaced four times over the same 4-month trapping period. Also, there is no need to replace the Flexlure midway through the season to maintain this efficiency.

Figure 1. Average number of male codling moths captured per week in traps baited with standard lure (replaced four times) or Flexlure (never replaced) in 15 blocks (values for standard lure are average of four traps/block, Flexlure one trap/block).

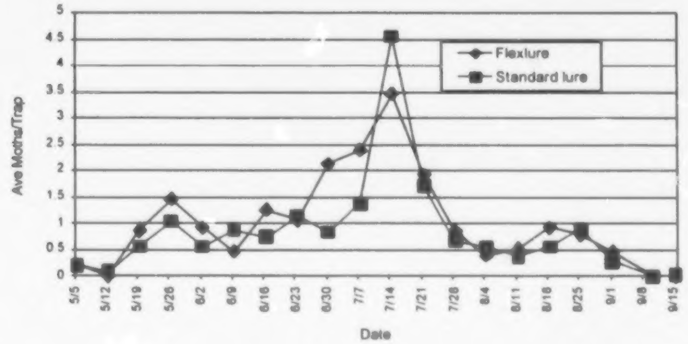
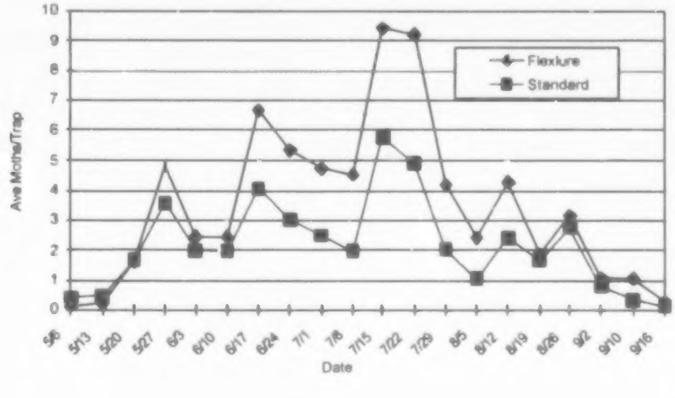


Figure 2. Average number of male codling moths captured per week in traps baited with standard lure (replaced four times) or Flexlure (replaced once) in 15 blocks (values for standard lure are average of four traps/block, Flexlure one trap/block).



END OF SECTION H (Pages 167-170; Reports 62-63).

SECTION I **INSECT AND MITE PEST SURVEYS AND OUTBREAKS** **ENQUÊTES PHYTOSANITIRES ET INFESTATIONS**

REPORTS /RAPPORTS # 64 - 65

PAGES: 171 - 174

Cross-reference. See related report # 63

EDITOR **Mr. Hugh G. Philip**

British Columbia Ministry of
Agriculutre and Food
200-1690 Powick Road
Kelowna, BC V1X 7G5

Email: hugh.philip@gems8.gov.bc.ca
Tel: (250) 861-7230
Fax: (250) 861-7490

1999 PMR REPORT # 64 **SECTION I: INSECT AND MITE SURVEYS AND OUTBREAKS**
STUDY DATA BASE: 375 - 1122 - 9614

CROP: Alfalfa (*Medicago officianalis* L.)
PEST: Alfalfa blotch leafminer (*Agromyza frontinella* (Rondani))

NAME AND AGENCY:

SOROKA, JJ
Agriculture and Agri-Food Canada, Saskatoon Research Centre
107 Science Place, Saskatoon, Saskatchewan S7N 0X2
Tel: (306) 956-7294 Fax: (306) 956-7247 Email: sorokaj@em.agr.ca
and
VENETTE, RC, HUTCHISON, WD, and BURKNESS, EC
United States Department of Agriculture - Animal and Plant Health Inspection Service
University of Minnesota, 1980 Folwell Avenue, 219 Hodson Hall, St. Paul, Minnesota 55108
Tel: (612) 624-3670 Fax: (612) 625-5299 E-mail: venet001@tc.umn.edu

TITLE: SURVEY FOR THE OCCURRENCE OF ALFALFA BLOTCH LEAFMINER IN CENTRAL AND NORTHERN SASKATCHEWAN

METHODS: On September 9, 1999 a survey of alfalfa fields was conducted by JJS in a northern circular route beginning and ending at Saskatoon, Saskatchewan. The method of field selection was to choose a field composed of more than 50% alfalfa that was at least25 km from the last sampling location. In the field, 30 stems of alfalfa were collected by randomly severing a stem at soil level every 3 to 5 walking steps in a transect at 30 stops across the field. The samples were inspected for alfalfa blotch leafminer damage and placed in a paper bag which was labeled with the global positioning system location, field type and size. Samples were immediately shipped via air express to RCV for closer examination.

RESULTS: Fourteen fields of alfalfa under various management practices were inspected in the survey. No damage that could be attributed to alfalfa blotch leafminer was seen in the field (JJS) or in the laboratory (RCV). Field locations and types are listed in Table 1.

CONCLUSIONS: The first record of alfalfa blotch leafminer in Canada was at St Armand, Quebec, in 1972. Since then it has spread westward, and has been found recently in many areas of Manitoba, including the Swan River Valley, which is similar to Saskatoon in latitude. Based on the results of this survey, alfalfa blotch leaf miner is not yet present in alfalfa in central and northern Saskatchewan. However, levels of leafminer damage were reported to be low in Manitoba in 1999, and the possibility exists that alfalfa blotch leafminer is present in Saskatchewan but in frequencies below the level of detection of this survey.

Table 1. Location of alfalfa fields sampled for the presence of alfalfa blotch leaf miner in north and central Saskatchewan on September 9, 1999.

Nearest Centre	GPS location	Field type	Field Size (ha)
Warman	N 52• 19.095' W106• 33.594'	one cut hay	9
Rosthern	N 52• 41.315' W106• 18.544'	second cut hay	30
Rosthern	N 52• 42.218' W106• 17.597'	seed alfalfa	50
Macdowall	N 53• 03.937' W105• 55.053'	one cut alfalfa/brome	10
Meath Park	N 53• 19.472' W105• 27.125'	one cut alfalfa/brome	40
Foxford	N 53• 27.380' W105• 07.534'	second cut hay	20
Choiceland	N 53• 28.913' W104• 26.300'	alfalfa dehy	30
Codette	N 53• 16.690' W104• 01.339'	alfalfa seed	30
Codette	N 53• 14.957' W103• 59.878'	alfalfa dehy	70
Tisdale	N 52• 50.644' W104• 04.204'	one cut alfalfa/grass	30
Beatty	N 52• 48.844' W104• 48.827'	second cut alfalfa/brome	10
Yellow Creek	N 52• 41.124' W105• 25.409'	one cut alfalfa/brome	15
Aberdeen	N 52• 12.364' W106• 21.637'	one cut alfalfa/brome	30
Saskatoon	N 52• 09.528' W106• 34.060'	research seed alfalfa	1

1999 RAPPORT # 65 SECTION I: ENQUÊTES PHYTOSANITIRES ET INFESTATIONS

CULTURE: Pommes
RAVAGEUR: Insectes et acariens

NOM ET ORGANISME:
CORMIER D CHOUINARD G et BELLEROSE S
Institut de recherche et de développement en agroenvironnement, 3300, rue Sicotte, C.P. 480
Saint-Hyacinthe, Québec, J2S 7B8
Téléphone: (450) 778 6522 Télécopieur: (450) 778 6539 Courriel: dcormier@irda.qc.ca

TITRE: **LES RAVAGEURS DES VERGERS DE POMMIERS DU QUÉBEC EN 1999.**

MÉTHODES: Dans sept vergers de pommiers commerciaux, une parcelle de 1-2 ha a été mise à la disposition du réseau d'avertissements phytosanitaires du pommier pour dépister les insectes et acariens nuisibles aux pommiers. Dans chacun de ces vergers-pilotes, le dépistage des lépidoptères a été fait à l'aide de pièges Phérocon et Multi-pher munis d'une capsule de phéromone, celui de la punaise terne et de l'hoplocampe des pommes à l'aide des cartons blancs englués, celui de la mouche de la pomme avec une sphère rouge engluée alors que les acariens et leurs prédateurs ont été suivis par échantillonnage visuel à l'aide d'une loupe 15X. Les pièges ont été posés entre le 6 avril et le 14 juin, soit au début de la période d'activité des insectes concernés, et ont été relevés à toutes les semaines jusqu'au début septembre. Au besoin les pièges ont été nettoyés ou remplacés et les capsules de phéromone ont été remplacées à toutes les 4 ou 5 semaines. Les dommages à la récolte ont été évalués au début septembre en échantillonnant entre 500 et 1000 pommes prises aléatoirement dans 50 à 100 arbres par verger. Ce bilan provincial des insectes et acariens reflète la situation générale observée dans l'ensemble des régions pomicoles et souligne les problèmes observés le plus fréquemment à travers la province.

RÉSULTATS: Voir le tableau ci-dessous.

CONCLUSIONS: Le nombre des captures d'adultes de la tordeuse à bandes obliques, *Choristoneura rosaceana* (Harris) a dépassé de 2 à 14 fois le nombre habituellement capturé en verger commerciaux. Les dommages causés par cet insecte dans les vergers-pilotes représentaient environ le tiers des dommages enregistrés par l'ensemble des insectes. Les dommages de la tordeuse à bandes obliques ont toutefois été inférieurs à la moyenne dans les vergers où un éclaircissage des pommes et une taille des gourmands ont été effectuées successivement pendant l'été. Ces deux activités réduisent le nombre de sites où la tordeuse à bandes obliques peut se réfugier et augmente l'efficacité des traitements par une meilleure pénétration des produits dans le feuillage. Le méthomyl (Lannate) et le *Bacillus thuringiensis* (Foray, Dipel) ont été les produits les plus utilisés dans les vergers ayant un problème récurrent de tordeuse à bandes obliques. Les organophosphorés sont tout de même demeurés utiles dans la plupart des régions où de la résistance n'a pas été démontrée. Les captures de la mineuse marbrée, *Phyllonorycter blancardella* (Fabr.), ont été supérieures à la moyenne des dix dernières années dans 70% des vergers-pilotes avec une augmentation des captures variant de 30% à 300%. Dans un verger non suivi par le réseau, le niveau des captures a été dix fois supérieur à celui habituellement observé, totalisant 165 000 adultes en première génération. Toutefois, un seul traitement insecticide dirigé contre les larves de la première génération au bouton rose a été efficace dans la majorité des vergers. Lorsqu'une seconde application a été nécessaire, Admire (imidachlopride) a été utilisé avec succès. Des niveaux élevés de parasitisme des larves de deuxième et troisième générations ont été observés et peu ou pas de conséquences à la récolte ont été rapportées. La densité des populations printanières de tétranyque rouge du pommier, *Panonychus ulmi* (Koch), était élevée en raison de la bonne survie des œufs hibernants. Les traitements avec l'huile supérieure ont été très efficaces pour les contrôler en raison des conditions abiotiques propices lors des applications. Les vergers traités avec Agri-Mek (abamectine) au stade bouton rose ou calice ont obtenu un contrôle du tétranyque rouge et aucun traitement subséquent n'a été nécessaire. Dans certains vergers traités avec Pyramite (pyridabène) on a observé un faible contrôle du tétranyque à deux points, *Tetranychus urticae* Koch. Comme en 1998, des populations de tétranyques de McDaniel, *Tetranychus mcdanieli* McGregor, ont été observées dans quelques vergers du sud-ouest du Québec. Dans plusieurs vergers, le nombre d'acariens phytophages a été maintenu sous les seuils économiques notamment par les prédateurs d'acariens dont les phytoséiides, les stigmaéides, la punaise de la molène, *Campylomma verbasci* (Meyer) et la punaise translucide *Hyaliodes vitripennis* (Say), qui ont été observés parfois en grand nombre. Les adultes de la mouche de la pomme, *Rhagoletis pomonella* (Walsh) ont été capturés pendant une période plus longue que la normale, soit de la fin juin à la mi-août. Le niveau élevé des populations a nécessité l'application d'au moins un traitement insecticide dans la majorité des vergers et très peu de dommages ont été détectés à la récolte. L'activité de l'hoplocampe des pommes, *Hoplocampa testudinea* (Klug) était très variable selon les régions. Dans les Cantons de l'Est et la région de Québec, un nombre élevé des captures a été enregistré et des traitements insecticides ont été nécessaires pour abaisser le niveau des populations sous le seuil économique. Dans toutes les autres régions peu de traitements ont été dirigés contre l'hoplocampe des pommes car les captures étaient plus faibles qu'à l'habitude. Le traitement effectué au calice avec un insecticide organophosphoré contre le charançon de la prune, *Conotrachelus nenuphar* (Herbst), a été habituellement efficace, mais dans quelques vergers un second traitement localisé en bordure du verger a été nécessaire. Les captures de la punaise terne, *Lygus lineolaris* (P. de B.), étaient égales ou inférieures à la normale dans la plupart des vergers. Le niveau de dommages causé aux fruits par la punaise terne et les autres punaises phytophages, *Lygocoris communis* (Knight), *Lygidea mendax* Reuter, *Heterocordylus malinus* Reuter,a été plus faible qu'à l'habitude dans la plupart des régions. Les populations de la tordeuse à bandes rouges, *Argyrotaenia velutinana* (Walker), et du carpocapse de la pomme *Cydia pomonella* L., ont atteint des niveaux égaux ou plus bas que la normale dans la plupart des vergers. Aucun traitement n'a été spécifiquement dirigé contre ces deux insectes et très peu de dommages ont été causé aux pommes.

Tableau 1. Pourcentage des dommages observés à la récolte dans les vergers-pilotes du réseau de 1991 à 1999.

	Ravageurs*								
Année	MOU	CARPO	CHEN	TBO	CHA	HOP	PUT	APP	PRESSION TOTALE
1991	0,00	0,00	0,80	0,10	0,20	0,20	1,90	0,90	4,70
1992	0,13	0,04	1,11	0,07	0,93	0,11	4,22	0,24	7,31
1993	0,07	0,00	1,18	0,00	0,07	0,04	1,64	0,27	3,38
1994	0,00	0,02	0,67	0,07	0,19	0,00	1,22	0,52	2,87
1995	0,04	0,00	1,14	0,04	0,33	0,60	2,04	0,60	4,98
1996	0,04	0,00	0,94	0,12	0,27	0,16	0,86	0,35	2,80
1997	0,00	0,00	1,22	0,13	0,04	0,18	0,77	0,11	2,67
1998	0,00	0,00	0,16	0,84	0,00	1,98	2,22	0,22	6,07
1999	**0,00**	**0,04**	**1,00**	**0,53**	**0,18**	**1,51**	**0,93**	**0,27**	**4,62**
1991-1998	0,04	0,01	0,90	0,17	0,25	0,41	1,86	0,40	4,35

*MOU: mouche de la pomme; CARPO: carpocapse de la pomme; CHEN: chenilles (incluant la première génération de TBO, tordeuse à bandes rouges et noctuelles); TBO: tordeuse à bandes obliques; CHA: charançon de la prune; HOP: hoplocampe des pommes; PUT: punaise terne; APP: autres punaises phytophages; TAV: tavelure du pommier; PRESSION TOTALE: pression totale par les insectes.

End of section I Reports 64-65. Previous report 65 by Gagnon et al. now #1-Hb, pp.166a-c.

FILE: 99DISEASES-PMRR.WPD

TITLE: 1999 PEST MANAGEMENT RESEARCH REPORT

SECTIONS: J - Q

REPORT #s: 66 - 129

PAGES: 175 - 358

SECTIONS J - Q			PLANT PATHOLOGY	PHYTOPATHOLOGIE
	Pages	Report #s		
J	175-207	66-78	Fruit - diseases	Fruit
K	208-238	79-89	Vegetables and special crops	Légumes et cultures spéciales
L	239-304	90-112	Field legumes	Légumineuses de grande culture (haricots, pois)
M	305-313	113-116	Potatoes	Pommes de terre
N	314-350	117-127	Cereal, forage and oilseed crops	Céréales, cultures fourragères et oléagineux
O	-	-	Ornamentals, greenhouse and turf	Plantes ornementales, de serre et de gazon
P	351-355	128	Nematodes	Nématodes
Q	356-358	129	Residues	Résidus

SECTION J: FRUIT / FRUITS

REPORTS /RAPPORTS # 66 - 78

PAGES: 175 - 207

EDITOR **Dr. Peter Sholberg**

Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre
4200 Hwy 97
Summerland, British Columbia V0H1Z0

Email: sholbergp@em.agr.ca
Tel: (250) 494-6383
Fax: (250) 494-0755

1999 PMR REPORT # 66 **SECTION J: FRUIT - DISEASES**
STUDY DATA BASE: 402-1531-8605

CROP: Apple, *(Malus domestica* Bork.) cv. Jonagold
PEST: Powdery mildew, *Podosphaera leucotrica* (Ell. and Ev.) Salm.

NAME AND AGENCY:
SHOLBERG P L and LASHUK, L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: EFFICACY OF MINERALL CLAY AGAINST POWDERY MILDEW ON APPLE, 1998

MATERIALS: MINERALL CLAY (glacial marine mud), NOVA 40 WP (myclobutanil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on eleven-year-old Jonagold apple trees on M7A rootstocks. Thirty-five trees in three rows were separated into 5 blocks of 7 random single tree replicates per block. The single tree replicates were separated from one another by a non-sprayed tree on each side. The five treatments were applied until run-off with a handgun operated at 345 kPa. Treatments were applied on 24 April (tight cluster), 5 May (full bloom), 15 May (petal fall), 26 May (first cover spray), and 5 June (second cover spray). Primary powdery mildew was evaluated on 26 May by counting 25 shoots and recording the number of terminals infected with powdery mildew. Secondary powdery mildew was evaluated on 19 June and 14 September for incidence and severity by randomly selecting 25 shoots per tree and estimating the percent area infected on two fully expanded leaves nearest the shoot tip. These counts were converted to percent infected leaves per tree, arcsin-transformed and subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). Means were separated with the Duncan's Multiple Range test.

RESULTS: Primary powdery was significantly less than the control in the NOVA treatment. Secondary powdery mildew incidence and severity was less for the NOVA treatment on 19 June and 14 September (Table 1). Severity of powdery mildew on the early infection date was significantly reduced by the low rate of CLAY. None of the treatments, when compared to the control, significantly reduced the number of apples russetted due to powdery mildew.

CONCLUSIONS: Primary powdery mildew was evaluated later than usual and the early sprays of NOVA may have reduced the number of shoots with visible infection. CLAY at the rates used in this trial did not prevent powdery mildew from spreading but did significantly reduce the severity. Possibly, more frequent applications, on a 5 to 7 days schedule from bloom until early July would provide effective control.

Table 1. Percent primary and secondary powdery mildew on Jonagold apple leaves and fruit.

Treatment and Rate/100L	Primary Shoot Mildew	Foliage Mildew Incidence		Foliage Mildew Severity*		Severe Fruit Mildew
		19 June	14 Sept	19 June	14 Sept.	
CONTROL	8.3 a**	90.4 a	87.6 ab	33.8 a	57.4 a	7.2 a
CLAY 2 Kg	1.9 ab	81.4 a	81.2 ab	19.4 b	48.7 ab	9.5 a
CLAY 4 Kg	8.0 a	86.2 a	91.3 a	24.8 ab	60.6 a	4.5 a
NOVA 11 g	0.0 b	14.3 b	77.4 b	1.5 c	37.9 b	3.7 a
ANOVA Pr>F	0.003	0.012	0.06	0.0001	0.036	0.848

* Mildew severity is the average percent mildew covering the leaf surface.

** These data were arcsin transformed prior to analysis of variance. The detransformed means are presented here. Figures are the means of 5 replications. Numbers followed by the same letter are not significantly different at $p = 0.05$ as decided by Duncan's Multiple Range Test.

1999 PMR REPORT # 67 SECTION J: DISEASES OF FRUIT
STUDY DATA BASE: 390 1252 9201

CROP: Highbush Blueberry (*Vaccinium corymbosum*)
PEST: Mummy Berry, *Monilinia vaccinii-corymbosi*
Fruit rots, *Botrytis cinerea, Colletotrichum gloeosporioides* and *Alternaria* sp.

NAME AND AGENCY:
BROOKES VR
Agriculture and Agri-Food Canada
Pacific Agri-food Research Centre, Agassiz, B.C. VOM 1A0
Tel: (604) 796-2221 x 228 Fax: (604)796-0359 E-mail: brookesv@em.agr.ca

TITLE: EFFICACY OF FUNGICIDES FOR THE CONTROL OF FRUIT ROT IN HIGHBUSH BLUEBERRIES IN 1999.

MATERIALS: MAESTRO 75 DF (captan), BENLATE 50 W (benomyl), ELEVATE 50 WDG (fenhexamid), ROVRAL 50 WDG (iprodione), SENATOR 70 WP (thiophanate methyl), BRAVO 500 G/L (chlorothalonil), STROBY 50 DF (kresoxim-methyl), SWITCH 65.2 WG (cyprodinil +fludioxonil), ALIETTE 80 WP (fosetyl-al).

METHODS: The trial was conducted in 1999 in a commercial blueberry planting at Abbotsford, B.C. in a field known to be infected with fruit rot. Blueberry rows were spaced 3 m apart. Plants were spaced 1.3 m apart within the row. Each treatment was applied to 4.1 m x 3 m plots replicated four times in a randomized complete block. Only the middle bush within each plot was assessed. Two untreated bushes at either end of each plot were left as a buffer between each treatment. The treatments were applied with a hand held boom attached to a pressurized CO2 backpack sprayer in 1000L/ha of water at a pressure of
350 kPA. MAESTRO, BENLATE, MAESTRO + BENLATE, ELEVATE and SENATOR were applied May 10, May 19 and June 3. ROVRAL was applied May 10 and May 19. BRAVO followed by MAESTRO, followed by ALIETTE followed by BRAVO, followed by MAESTRO was applied April 16, May 10, May 19, June 3 and June 17. STROBY and SWITCH were applied May 10, May 19, June 3 and June 17. At the green berry stage 100 berries from each plot were picked and examined for signs of mummyberry. Harvest began on July 29 and continued until August 31. At each picking, marketable, rot and cull weights were recorded. Size index based on the gram weight of 50 marketable berries was also recorded at each picking. A postharvest fruit rot trial was also set up. Twenty randomly picked berries from the marketable yield were placed on styrofoam plates covered with damp paper towels. The plates were then covered with plastic wrap. Two sets of all treatments were made. One set was left at ambient temperature and rots counted approximately 10 days later. The other set was put in cold storage at 2• C for approximately 10 days and left at ambient temperature and rots counted approximately 6 days later. Three postharvest rots developed: *Botrytis cinerea, Colletotrichum gloeosporioides*, and *Alternaria* sp. Data were analysed with the general linear models procedure (SAS institute, Cary, NC) and means were separated using the Duncan's Multiple Range Test.

RESULTS: Data are presented in Tables 1, 2 and 3. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: There was very little mummyberry infection this year and there were very few field rots. Size index was increased by all treatments except for MAESTRO and BENLATE applied alone. In the storage trials *Botrytis cinerea* was the main rot. There were few rots due to *Colletotrichum gloeosporioides* and *Alternaria* sp. until the later long term storage trial. There was a trend for *Botrytis cinerea* to be reduced by all treatments.

Table 1. Marketable weight, rot weight and percentage field rot of blueberries.

Treatment	Rate (grams ai/ha)	No of Appn*	Marketable Weight (grams/m^2)	Rot Weight (grams/m^2)	Size Index (grams/m^2)	% Rot
CHECK	-	-	545.5 a**	2.9 a	41.2 b	0.6 a
MAESTRO	1800	3	555.9 a	4.8 a	47.9 b	1.0 a
BENLATE	550	3	737.9 a	3.9 a	45.6 ab	0.5 a
MAESTRO + BENLATE	1500 + 550	3	661.9 a	1.9 a	50.0 a	0.3 a
ELEVATE	840	3	609.3 a	4.1 a	50.3 a	0.6 a
ROVRAL + TRITON	1000 + 0.1%	2	612.1 a	5.4 a	50.0 a	0.9 a
SENATOR	770	3	620.3 a	3.3 a	47.9 a	0.6 a
BRAVO fb MAESTRO*** fb ALIETTE fb BRAVO fb MAESTRO	4e+19	11111	641.5 a	4.6 a	49.0 a	0.8 a
STROBY	100	4	705.9 a	2.3 a	51.2 a	0.4 a
SWITCH	625	4	568.3 a	2.9 a	47.9 a	0.5 a

* No of Appn = number of applications

** These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

*** fb = followed by.

Table 2. Percentage of berries infected by *Botrytis cinerea* after being stored at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	No of Appn*	Aug.3** Aug.13	Aug. 9 Aug. 17	Aug. 16 Aug. 26
CHECK	-	-	48.8 a***	46.3 a	77.5 a
MAESTRO	1800	3	13.8 bc	23.8 ab	70.0 ab
BENLATE	550	3	16.3 bc	25.0 ab	58.8 ab
MAESTRO + BENLATE	1500 +550	3	10.0 bc	23.8 ab	56.3 ab
ELEVATE	840	3	28.8 b	23.8 ab	61.3 ab
ROVRAL + TRITON	1000 +0.1%	2	5.0 c	28.8 ab	58.8 ab
SENATOR	770	3	15.0 bc	33.8 ab	42.5 b
BRAVO fb MAESTRO **** fb ALIETTE fb BRAVO fb MAESTRO	3.6e+19	11111	16.3 bc	31.3 ab	58.8 ab
STROBY	100	4	15.0 bc	25.0 ab	52.5 ab
SWITCH	625	4	11.3 bc	17.5 b	61.3 ab

* No of Appn = number of applications.

** First date: set up, second date: rots counted.

*** These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

**** fb = followed by.

Table 3. Percentage of berries infected by *Botrytis cinerea* after being held in cold storage, then at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	No of Appn[1]	*Botrytis cinerea* (%)		*Colletotrichum gloeosporioides* (%)	*Alternaria* sp. (%)
			Aug. 3[2] Aug. 13 Aug.19	Aug.23 Sept. 2 Sept. 10	Aug.23 Sept. 2 Sept. 10	Aug.23 Sept. 2 Sept. 10
CHECK	-	-	30.0 a[3]	10.0 a	21.3 a	27.5 ab
MAESTRO	1800	3	15.0 bc	0.0 b	3.8 a	32.5 a
BENLATE	550	3	12.5 c	2.5 b	21.3 a	13.8 ab
MAESTRO + BENLATE	1500 +550	3	18.8 abc	1.3 b	3.8 a	22.5 ab
ELEVATE	840	3	25.0 ab	1.3 b	11.3 a	20.0 ab
ROVRAL + TRITON	1000 +0.1%	2	6.3 c	3.8 b	2.5 a	13.8 ab
SENATOR	770	3	6.3 c	3.8 b	3.8 a	10.0 b
BRAVO fb MAESTRO[4] fb ALIETTE fb BRAVO fb MAESTRO	3.6e+19	11111	11.3 c	2.5 b	0.0 a	16.3 ab
STROBY	100	4	11.3 c	0.0 b	5.0 a	10.0 b
SWITCH	625	4	10.0 c	1.3 b	1.3 a	10.0 b

[1] No of Appn = number of applications.

[2] First date: set up; second date: berries taken out of storage; third date: rots counted.

[3] These values are the means of four replications. Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

[4] fb = followed by.

1999 PMR REPORT # 68 SECTION J: PLANT PATHOLOGY, FRUIT CROP DISEASES
ICAR # 206005

CROP: Grape (*Vitis vinifera* L.), cv. Chardonnay grafted on Couderc 3309 rootstock.
PESTS: Powdery mildew (*Uncinula necator* (Schw.) Burr.)

NAME AND AGENCY:
MCFADDEN-SMITH, W., WEARING, L.P. and WRIGHT, D.S.
Department of Plant Agriculture
Horticultural Research Institute of Ontario
University of Guelph
4890 Victoria Ave. N., Box 7000, Vineland Station, Ontario L0R 2E0
Tel: (905) 562-4141 Fax: (905) 562-3413 E-mail: wmcfadde@uoguelph.ca

TITLE: EFFICACY OF FUNGICIDE TREATMENTS FOR CONTROL OF GRAPEVINE POWDERY MILDEW AT VINELAND STATION, ONTARIO, 1999

MATERIALS: FLINT (trifloxystrobin); SOVRAN (kresoxim-methyl); ABOUND (azoxystrobin); KUMULUS 80DF (sulphur); NOVA 40W (myclobutanil)

METHODS: Treatments were applied to 5- or 6-vine plots at Vineland Station, ON with a hydraulic tunnel sprayer at a rate of 500 L water per ha pre bloom, 1000 L per ha post bloom. A conventional grower program and an unsprayed check were also maintained in this trial. The growth stages and rates for application of materials are provided in Table 1. Treatments were replicated four times. Incidence and severity of powdery mildew were evaluated July 14 and August 30 on 50 random leaves and 50 random clusters on the middle three vines per plot using a modified Barratt Horsfall rating scale (0-6 where 0= no disease, 1 = 0-1%, 2 = 2-10%, 3 = 11-25%, 4 = 26-50%, 5 = 51-75% and 6 = 76-100% of leaf/cluster area affected). Values were converted to % for analysis. At commercial ripeness (Brix approx. 22•) all fruit were collected from a 1 m section of the test plot. The number of clusters and total fruit weight were recorded. Juice from a 100 g sub-sample of the fruit was analyzed for soluble solids (Brix), pH and titratable acids. Data for disease incidence and severity were arcsine transformed and analyzed using ANOVA (SAS).

RESULTS: Due to the very dry conditions of May and June, powdery mildew was slow to develop. However, conditions during July and August were very conducive to disease development. All treatments provided control of powdery on leaves and fruit at both sampling dates relative to the unsprayed treatment. The Flint and Sovran programs provided superior control of powdery mildew on fruit compared to the grower and Abound I treatments by late August. The Abound II program provided better control of powdery mildew on fruit compared to the Abound I program, but the reverse was true for foliar disease. No significant effect was observed by any of the treatments with respect to number of clusters, weight of fruit, soluble solid accumulation, pH or titratable acids. No phytotoxicity was observed in any of the plots.

CONCLUSIONS: Under the conditions of this trial, all the fungicides tested controlled powdery mildew. Flint and Sovran, incorporated in an IPM resistance management schedule, provided the best control of powdery mildew.

Table 1. Incidence and severity of powdery mildew on grape cv. Chardonnay on July 14 and August 30 in vineyard field trials at Vineland Station, 1999

Treatment Program[1]	July 14 Infection Rating				August 30 Infection Rating			
	Foliar		Fruit		Foliar		Fruit	
	%[2]	Area[2]	%	Area	%	Area	%	Area
Grower[3]	0.0 a[8]	0.0 a	0.0 a	0.0 a	1.5 a	0.0 a	13.7 b	0.1 b
Sovran[4]	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Flint[5]	0.0 a	0.0 a	0.0 a	0.0 a	1.0 a	0.0 a	0.7 a	0.0 a
Abound I[6]	0.0 a	0.0 a	0.0 a	0.0 a	36.0 b	0.9 b	6.7 ab	0.0 a
Abound II[7]	0.0 a	0.0 a	0.0 a	0.0 a	5.1 a	0.0 a	20.8 b	0.1 c
Untreated	35.5 b	0.1 b	14.0 b	0.0 b	97.5 b	49.6 c	99.3 c	59.1 d

[1] Sprays were applied 1) 20 May (12 -15 cm shoot length), 2) 31 May (20-25 cm shoot length), 3) 16 June (immediate pre-bloom), 4) 23 June (immediate post-bloom), 5) 8 July (fruit set), 6) 22 July. (berry touch), 7) 5 August (veraison), and 8) 18 August (2 weeks after veraison).

[2] Data represent means converted to %.

[3] Grower Program: Sprays 1, 2, 5, 6 & 8 - Kumulus 80DF (12.6 kg/ha); Sprays 3, 4 & 7 - Nova 40W (200 g/ha).

[4] Sovran Program: Sprays 1-8 Sovran 50WDG (300 g/ha).

[5] Flint Program: Spray 1, 3, 4, and 7 - Flint 50WG (140 g/ha) ; Sprays 2, 6 and 8 - Kumulus 80DF (12.6 kg/ha); Spray 5 - Nova 40W (200) g/ha.

[6] Abound I Program: Sprays 1, 3, 5 and 7 - Abound 250SC (0.8 L/ha); Sprays 2, 6 & 8 - Kumulus 80DF (12.6 kg/ha); Spray 4 - Nova 40W (200 g/ha).

[7] Abound II Program: Sprays 1-8 Abound 250SC (0.8L/ha).

[8] Values in a column followed by the same letter are not significantly different according to the Waller-Duncan K-ratio test (á=0.05).

1999 PMR REPORT # 69 **SECTION J: FRUIT - Diseases**
ICAR: 88880030

CROP: Grape, *Vitis vinifera,* cv. Pinot noir (clone 93 Ritter)
PEST: Powdery mildew, *Uncinula necator* (Schwein) Burrill
Bunch rot, *Botrytis cinerea* Pers.:Fr.

NAME AND AGENCY:
SHOLBERG P L, and LASHUK L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: EFFICACY OF VANGARD AGAINST POWDERY MILDEW AND BUNCH ROT ON GRAPE, 1998

MATERIALS: VANGARD 75 WG (cyprodinil), NOVA 40W (myclobutanil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 8 year old vines. The cordon trained, spur pruned vines (ca. 20 nodes/m row) on 5C rootstocks with vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block with 18 m^2 per replicate with four replicates per treatment. Each 5-vine replicate had vines 1 and 5 as guards, thus treatments were separated by 2-vine buffers. The five treatments were applied until run-off with a handgun operated at approximately 3,000 kPa at a rate of 1800 L before foliage followed by 5,500 L water/ha after development of foliage. All treatments were applied on May 22 (early bloom), June 11 (berry touch), and September 23 (7 days preharvest). Of the two VANGARD treatments only one was applied on August 24 along with the NOVA treatment. Blossom clusters removed from the vineyard on June 12, were evaluated for infection by *Botrytis cinerea* on June 22, by counting the number of clusters with obvious *B. cinerea* infection, confirmed by microscopic examination. *B. cinerea* growth had been induced by surface sterilizing and dipping the clusters in a paraquat solution (6 g/L paraquat), and placing them (4 clusters per replicate) in a humid chamber at 20 C for 10 days. Incidence of powdery mildew was evaluated initially on September 9, by examining ten leaves on each of four shoots per vine, and again after harvest on October 15, on one shoot per vine, but this time percent infection per leaf was evaluated so powdery mildew severity could be determined. Also on October 15, powdery mildew infection of canes was determined by visually examining five internodes on each of three canes per vine and estimating percent infection. At harvest on October 7 powdery mildew in clusters was determined by examining 10 clusters per three vines for incidence of powdery mildew on the berries. Also at harvest, yield, number of clusters and number of clusters with bunch rot were recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. At harvest 10 clusters per replicate were randomly selected from the harvested fruit and placed in large ziplok polyethylene bags and incubated at 20 C for 6 days when bunch rot was recorded. Counts of blossom cluster infection, leaf and cane powdery mildew and cluster mildew and bunch rot were converted to the percent infected per replicate and arcsin-transformed. Number of clusters and yield and the transformed data for blossom cluster infection, leaf, cane, and cluster mildew were subjected to analysis of variance with the General Linear Models Procedure (SAS

Institute, Cary, NC). The Duncan's Multiple Range Test was used to separate means (P = 0.05).

RESULTS: VANGARD at three or four applications was not effective in controlling powdery mildew of pinot noir grapes (Table 1). In fact there were significantly more clusters of pinot noir grapes treated with VANGARD that had powdery mildew than in the control treatment. Powdery mildew severity averaged 41% for all treatments with no significant differences. VANGARD was effective early in the season in preventing infection of blossom clusters by *Botrytis cinerea*. However at harvest there was no significant difference in bunch rot between VANGARD treated grapes and the check. Grape bunches incubated at 20 C developed more bunch rot but the increased disease was equally distributed. VANGARD had no adverse affect on the number of clusters or yield.

CONCLUSIONS: VANGARD is not effective for controlling powdery mildew of grapes. VANGARD significantly reduced infection of grape blossom clusters by *B. cinerea* and likely would have reduced bunch rot in this trial if the disease had been more prevalent.

Table 1. Pinot noir grape powdery mildew, blossom infection, bunch rot, and yield.

Treatment & Rate/ 100L	Powdery Mildew (%)			Botrytis Infect. (%)	Bunch Rot (%)	Clusters (No.)	Yield (Kg)
	Leaves 09 Sept.	Leaves 15 Oct.	Clusters 07 Oct.				
Control -----	7.9b*	65.8ab	5.0b	75.0a	15.0a	203.0a	21.3a
NOVA 7.5 g	7.7b	50.0a	0.0b	93.8a	7.5a	206.0a	21.5a
VANGARD 27.8g (3 applications)	36.2a	88.3b	30.0a	12.5b	2.5a	198.0a	19.7a
VANGARD 27.8g (4 applications)	20.4ab	75.8ab	5.0b	6.2b	7.5a	228.0a	21.9a
ANOVA Pr>F	0.06	0.08	0.01	0.004	0.69	0.52	0.91

* Figures are the means of four replications. Numbers followed by the same letter are not significantly different at p=0.05 as decided by the Duncan Multiple Range Test.

1999 PMR REPORT # 70 **SECTION J: FRUIT - Diseases**
ICAR: 88880030

CROP: Grape, *Vitis vinifera* cv. Chancellor
PEST: Powdery mildew, *Uncinula necator* (Schwein) Burrill
Bunch rot, *Botrytis cinerea* Pers.:Fr.

NAME AND AGENCY:
SHOLBERG P L and LASHUK L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: **EFFICACY OF ROVRAL COMBINED WITH NOVA AGAINST POWDERY MILDEW AND BUNCH ROT ON GRAPE, 1998**

MATERIALS: NOVA 40W (myclobutanil), ROVRAL 50 W (iprodione)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 8 year old vines. Spacing was 1.5 x 3.0 m (vine by row). The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block with four replicates. Each 3-vine replicate had one half of vines 1 and 3 as guards, thus treatments were separated by 2 half-vine buffers. The six treatments were applied until run-off with a handgun operated at approximately 3,000 kPa at a rate of 1,800 L water/ha. All treatments were applied on 22 May (early bloom). On 11 June (berry touch) and 24 August (veraison) five treatments were applied and leaving out one of the combined ROVRAL plus NOVA treatments. The final application of all treatments was made on 24 September (6 days preharvest). Five clusters per replicate obtained from the vineyard on 12 June were placed on a plate (10 cm dia.) containing approx. 20 mL of Paraquat-chloramphenicol agar (PCA) and incubated at 20• C for a week when number of colonies growing on the medium were identified and counted. Four clusters per replicate obtained from the vineyard on 12 June after the second spray were evaluated for infection by *Botrytis cinerea* on 22 June by counting the number of clusters with obvious *B. cinerea* infection, confirmed by microscopic examination. In this case *B. cinerea* growth had been induced by surface sterilizing and dipping the clusters in a paraquat solution (6 g/L paraquat), and placing them (4 clusters per replicate) in a humid chamber at 20• C for 10 days. Incidence of powdery mildew was evaluated initially on September 9, by examining ten leaves on each of four shoots per vine, and again on 15 October which was 15 days after harvest, on one shoot per vine, but this time percent infection per leaf was evaluated so powdery mildew severity could be determined. Also on 15 October, powdery mildew infection of canes was determined by visually examining five internodes on each of three canes per vine and estimating percent infection. At harvest powdery mildew in clusters was determined by examining 10 clusters per three vines for incidence of powdery mildew on the berries. Also at harvest, yield, number of clusters and number of clusters with bunch rot were recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. At harvest 10 clusters per replicate were randomly selected from the harvested fruit and placed in large ziplok polyethylene bags and incubated at 20• C for 6 days after which bunch rot was recorded. Counts of blossom cluster infection, leaf and cane powdery mildew and cluster mildew and bunch rot were converted to the percent infected per replicate and arcsin-transformed. Number of clusters and yield and the transformed data for blossom cluster infection, leaf, cane, and cluster mildew were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range Test was used to separate means (P = 0.05).

RESULTS: Only *Alternaria* spp. colonies grew from the grape clusters after the first spray was applied. Ninety-eight percent of the control clusters were associated with *Alternaria* colonies (Table 1). All the treatments that contained ROVRAL significantly reduced the number of *Alternaria* colonies. After the second spray, when clusters were tested for *B. cinerea* the high and low rates of ROVRAL significantly reduced the number of clusters infected with *B. cinerea*. Leaf powdery mildew evaluated on 9 September indicated no significant differences between treatments. However, on 15 October incidence of powdery mildew on leaves was reduced from 93 to 36% by four applications of NOVA and to 3.8% by four combined applications of ROVRAL and NOVA. Severity of powdery mildew (mean leaf area covered by powdery mildew) was also significantly less for these two treatments. The four applications of NOVA with ROVRAL significantly reduced the percent of clusters with powdery mildew from 74.6 to 3.8%.
None of the treatments significantly reduced cane powdery mildew in this trial. Grape bunch rot was not significantly reduced by any of these treatments at harvest or after the grape bunches were incubated at 20• C. Yield or number of clusters were not significantly affected by any of these treatments.

CONCLUSIONS: ROVRAL alone was not effective for the control of grape powdery mildew. However when combined with NOVA and applied at least four times at key times during the growing season it was very effective in controlling leaf and cluster powdery mildew. In one case, incidence of leaf powdery mildew on 15 October, the combination was even significantly better than NOVA alone suggesting that there may be a synergistic effect. If bunch rot would have been more prevalent in this trial, ROVRAL in combination with NOVA likely would have controlled this disease because both rates of ROVRAL tested significantly reduced *B. cinerea* infection in newly formed grape berry clusters.

Table 1. Chancellor grape powdery mildew, *Alternaria* and *Botrytis* spp. infection, and yield

Treatment and Rate/100 L		% Powdery Mildew			% Leaf Area with mildew	% *Alternaria* Blossom Infection	% *Botrytis* Blossom Infection	Yield (Kg)
		Leaves 15 Oct	Canes 15 Oct	Clusters 1 Oct				
CONTROL		93.3a*	52.1a	74.6a	45.7a	98.1a	100.0a	50.5a
NOVA	7.5g	36.2b	45.2a	2.6c	7.0b	82.1ab	98.3a	58.1a
ROVRAL	56.2 g	77.2a	33.4a	21.3cb	26.9a	20.8d	43.5b	62.0a
ROVRAL	85.2 g	80.3a	35.2a	60.1ab	29.4a	35.8dc	43.5b	42.8a
ROVRAL + + NOVA	56.2g 7.5g	3.8c	30.5a	3.8c	0.4b	58.0bc	85.3ab	34.9a
ROVRAL** + NOVA	56.2 g 7.5g	83.1a	39.1a	29.4abc	38.5a	41.6dc	85.3ab	64.4a
ANOVA	Pr> F	0	0.389	0.006	0	0.001	0.006	0.47

* Figures are the means of four replications. Numbers followed by the same letter are not significantly different at p=0.05 as decided by the Duncan Multiple Range Test.

** This treatment consisted of two applications applied on 22 May and 24 September, 1998, all the other treatments were four applications.

1999 PMR REPORT # 71 **SECTION J: FRUIT - DISEASES**
ICAR: 88880030

CROP: Grape, *Vitis vinifera* cv. Chancellor
PEST: Powdery mildew, *Uncinula necator* (Schwein) Burrill
Bunch rot, *Botrytis cinerea* Pers.:Fr.

NAME AND AGENCY:
SHOLBERG P L and LASHUK L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: EFFICACY OF ELEVATE AGAINST POWDERY MILDEW AND BUNCH ROT OF GRAPE, 1998

MATERIALS: ELEVATE 50 WDG (fenhexamid), NOVA 40W (myclobutanil), ROVRAL 50 W (Iprodione)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. on 8 year old vines. Spacing was 1.5 x 3.0 m (vine by row). The cordon trained, spur pruned vines (ca. 20 nodes/m row) on vertical trained canopies were hedged around lag phase of berry development. The experimental design was a randomized complete block with four replicates. Each 3-vine replicate had one half of vines 1 and 3 as guards, thus treatments were separated by 2 half-vine buffers. The six treatments were applied until run-off with a handgun operated at approximately 3,000 kPa at a rate of 700 L water/ha. All treatments were applied on 22 May (early bloom), 11 June (berry touch), 24 August (veraison), and 24 September (6 days preharvest). Five clusters per replicate obtained from the vineyard on 12 June were placed on a plate (10 cm dia.) containing approx. 20 mL of Paraquat-chloramphenicol agar (PCA) and incubated at 20• C for a week when number of colonies growing on the medium were identified and counted. Only the high rate of ELEVATE was tested in this experiment. Four clusters per replicate obtained from the vineyard on 12 June after the second spray were evaluated for infection by *Botrytis cinerea* on 22 June by counting the number of clusters with obvious *B. cinerea* infection, confirmed by microscopic examination. In this case *B. cinerea* growth had been induced by surface sterilizing and dipping the clusters in a paraquat solution (6 g/L paraquat), and placing them (4 clusters per replicate) in a humid chamber at 20• C for 10 days. Incidence of powdery mildew was evaluated initially on September 9, by examining ten leaves on each of four shoots per vine, and again on 15 October which was 15 days after harvest, on one shoot per vine, but this time percent infection per leaf was evaluated so powdery mildew severity could be determined. Also on 15 October, powdery mildew infection of canes was determined by visually examining five internodes on each of three canes per vine and estimating percent infection. At harvest powdery mildew in clusters was determined by examining 10 clusters per three vines for incidence of powdery mildew on the berries. Also at harvest, yield, number of clusters and number of clusters with bunch rot were recorded. Clusters were considered to have bunch rot if gray mold was observed growing among the berries. At harvest 10 clusters per replicate were randomly selected from the harvested fruit and placed in large ziplok polyethylene bags and incubated at 20• C for 6 days when bunch rot was recorded. Counts of blossom cluster infection, leaf and cane powdery mildew and cluster mildew and bunch rot were converted to the percent infected per replicate and arcsin-transformed. Number of clusters and yield and the transformed data for blossom cluster infection, leaf, cane, and cluster mildew were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range Test was used to separate means (P = 0.05).

RESULTS: Only *Alternaria* spp. colonies grew from the grape clusters after the first spray was applied. Ninety-eight percent of the control clusters were associated with *Alternaria* colonies (Table 1). The high rate of ELEVATE did not significantly reduce the percent of *Alternaria* colonies compared to the control treatment. After the second spray, when clusters were tested for *B. cinerea* the low rate of ELEVATE significantly reduced the number of clusters infected with *B. cinerea*. Leaf powdery mildew incidence evaluated on 9 September and 15 October indicated that ELEVATE was not significantly more effective than the control on both dates although the trend was for the high rate of ELEVATE to have lower powdery mildew incidence than the low rate or ROVRAL. Severity of powdery mildew (mean leaf area covered by powdery mildew) was not significantly different than the control. However, the high rate of ELEVATE and NOVA significantly reduced the percent of clusters with powdery mildew from 74.6 to 16.7, and 2.6% respectively. None of the treatments significantly reduced cane powdery mildew in this trial. Grape bunch rot did not occur in any of the treatments at harvest, and when the grape bunches were incubated at 20• C for 9 days only a few bunches developed bunch rot with no significant differences between treatments. Yield or number of clusters were not significantly effected by any of these treatments.

CONCLUSIONS: Indications are that ELEVATE will reduce bunch rot similar to ROVRAL, because the low rate of ELEVATE significantly reduced *Botrytis* infection in grape bunches shortly after flowering. It was not possible to determine in this trial if ELEVATE would reduce bunch rot because bunch rot did not develop due to the relatively dry harvest period. ELEVATE showed signs that it was effective against powdery mildew because it reduced the number of bunches with symptoms of powdery mildew infection. However it did not significantly reduce leaf or cane powdery mildew compared to the control and was not as effective as NOVA in controlling powdery mildew.

Table 1. Chancellor grape powdery mildew, *Alternaria* spp. and *Botrytis* spp. infection, cluster number and yield.

Treatment	Product /100 L	Percent Powdery Mildew			*Alternaria* colonieson PCA plates (%)	Blossom Infect. by *Botrytis* (%)	No. Of Clusters	Yield (Kg)
		Leaves 15 Oct.	Severity 15 Oct.	Clusters 15 Oct.				
Check	---	93.3 a*	45.7 a	74.6 a	98.1 a	100.0 a	441 a	50.5 a
NOVA	7.5 g	36.2 b	7.0 b	2.6 c	82.1 ab	98.3 a	467 a	58.1 a
ROVRAL	56.2 g	77.2 a	26.9 a	21.3 cb	20.8 d	43.5 b	444 a	62.0 a
ELEVATE	16.0 g	91.7 a	47.5 a	66.7 ab	----	43.5 b	510 a	63.9 a
ELEVATE	21.3 g	75.1 a	36.6 a	16.7 c	92.8 a	96.2 a	448 a	62.9 a
ANOVA	Pr>F	0.0190	0.0124	0.024	0.0110	0.002	0.263	0.619

* Figures are the means of four replications. Numbers followed by the same letter are not significantly different at p=0.05 as decided by the Duncan Multiple Range Test.

1999 PMR REPORT # 72 **SECTION J: FRUIT - Diseases**
ICAR:8888030

CROP: Peach (*Prunus persica* (L.) Batsch), cv. Harbrite
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

NAME AND AGENCY:

SHOLBERG P L and LASHUK, L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: USE OF VANGARD FOR CONTROL OF BROWN ROT OF PEACHES IN 1998

MATERIALS: ROVRAL 50 WP (iprodione), VANGARD 75 WG (cyprodinil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. in an orchard block consisting of 15 mature peach trees. The experimental design was a randomized complete block with treatments replicated four times on single tree replicates. The treatments were applied until run-off with a CO_2 backpack sprayer on April 21 (full bloom) and April 30 (husk fall). The remaining sprays were applied by handgun operated at 350 kPa on July 16 (14 days before harvest), and

July 29 (1 day before harvest). Number of blighted blossoms were counted on April 30 by visually examining each tree for withered blossoms. Fruit brown rot was assessed at harvest on July 30 by evaluating all fruit per tree for brown rot. Fifty healthy fruit were harvested from each single tree replicate and were incubated at 20• C for 7 days when brown rot was recorded. The infected fruit were removed from the room and the remaining fruit were incubated for an additional 3 days when brown rot was recorded for a second time. These values were converted to percent infected and the arcsin transformed values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range test was used for multiple comparison of means and the detransformed means were reported.

RESULTS: Blossom blight did not occur in this trial and attempts to reproduce it in the greenhouse on detached twigs was not successful. Very few fruit at harvest had brown rot averaging 1.0• 1.0 per single tree replicate. However significant brown rot developed in fruit incubated for 7 days. VANGARD significantly reduced brown rot of peaches stored at 20• C for 7 and 10 days (Table 1).

CONCLUSIONS: VANGARD is an effective fungicide for controlling fruit brown rot of peaches and compared very well with ROVRAL in this trial.

Table 1. Percent Harbrite peaches with brown rot after incubation for 7 and 10 days.

Treatment	Rate of Product /100L	Infected Fruit after 7 days	Infected Fruit after 10 days
CHECK	----	46.4 a*	53.8 a
ROVRAL	144.2 g	9.7 bc	16.4 c
VANGARD	71.3 g**	4.0 c	17.8 c
ANOVA Pr>F		0.007	0.003

* These values are means of five replications. Raw data were arcsin transformed before ANOVA and the detransformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** VANGARD was applied at 35.6 g/100 L for the two bloom sprays and 71.3 g/100 L for the two fruit sprays.

1999 PMR REPORT # 73 **SECTION H: FRUIT - Diseases**
ICAR:8888030

CROP: Peach (*Prunus persica* (L.) Batsch), cv. Harbrite
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

NAME AND AGENCY:
SHOLBERG P L and LASHUK, L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: USE OF ABOUND FOR CONTROL OF BROWN ROT OF PEACHES IN 1998

MATERIALS: ABOUND FLOWABLE (22.9% azoxystrobin), ROVRAL 50 WP (iprodione) VANGARD 75 WG (cyprodinil)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. in an orchard block consisting of 24 mature peach trees. The experimental design was a randomized complete block with treatments replicated four times on single tree replicates. The treatments were applied until run-off with a CO_2 backpack sprayer on April 21 (full bloom) and April 30 (husk fall). The remaining sprays were applied by handgun operated at 350 kPa on May 29 (cover spray of ROVRAL was applied only to the ABOUND replicates), July 16 (14 days before harvest), and July 29 (1 day before harvest). Number of blighted blossoms were counted on April 30 by visually examining each tree for withered blossoms. Fruit brown rot was assessed at harvest on July 30 by evaluating all fruit per tree for brown rot. Fifty healthy fruit were harvested from each single tree replicate and were incubated at 20• C for 7 days when brown rot was recorded. The infected fruit were removed from the room and the remaining fruit were incubated for an additional 3 days when brown rot was recorded for a second time. These values were converted to percent infected and the arcsin transformed values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range test was used for multiple comparison of means and the detransformed means were reported.

RESULTS: Blossom blight did not occur in this trial and attempts to reproduce it in the greenhouse on detached twigs was not successful. Very few fruit at harvest had brown rot averaging 1.0±1.0 per single tree replicate. However significant brown rot developed in fruit incubated for 7 days. All fungicides that were tested reduced brown rot (Table 1). ABOUND at the low, medium, and high rate was as effective as the ROVRAL standard and ABOUND at the medium and high rate was as effective as VANGARD applied at the higher fruit rate. The remaining fruit incubated for another 3 days continued to develop brown rot. In this fruit the low rate of ABOUND was not significantly better than the control fruit. On the other hand the medium rate of ABOUND was as effective as VANGARD and ROVRAL in reducing decay.

CONCLUSIONS: Under the conditions of this trial ABOUND significantly reduced fruit brown rot. ABOUND at the medium and high rate was as effective as ROVRAL and VANGARD in controlling fruit brown rot. The low rate of ABOUND was weaker than the medium and high rates suggesting that only these rates should be considered for peach brown rot control. Note that a ROVRAL cover spray was applied to only the ABOUND replicates on May 29, 62 days before harvest as an anti-resistance strategy. It is unlikely that this extra cover spray would have had a noticeable effect on the final outcome of the trial.

Table 1. Percent Harbrite peaches with brown rot after incubation for 7 and 10 days.

Treatment	Rate of Product /100L	% Infected Fruit after 7 days	% Infected Fruit after 10 days
CHECK	---	46.4 a*	53.8 a
ABOUND LOW**	19.3 mL	18.5 b	37.0 ab
ABOUND MED**	38.5 mL	13.0 bc	24.7 bc
ROVRAL	144.2 g	9.7 bc	16.4 c
VANGARD	71.3 g***	4.0 c	17.8 c
ABOUND HIGH**	57.6 mL	9.8 bc	9.8 c
ANOVA Pr>F		0.007	0.003

* These values are means of four replications. Raw data were arcsin transformed before ANOVA and the detransformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** ROVRAL at the 90 g/100 L rate was applied as a cover spray to the ABOUND replicates on May 29 as part of an anti-resistance strategy.

*** VANGARD was applied at 35.6 g/100 L for the two bloom sprays and 71.3 g/100 L for the two fruit sprays.

1999 PMR REPORT # 74 SECTION J: FRUIT - Diseases
STUDY DATA BASE: 402-1252-9715

CROP: Raspberry, cv. Willamette
PEST: *Botrytis cinerea, Rhizopus* sp., *Cladosporium sp.*

NAME AND AGENCY:
BROOKES V R
Agriculture & Agri-Food Canada
PARC, Agassiz, B.C. V0M 1A0
Tel: (604) 796-2221 Fax: (604) 796-0359 E-mail: brookesv@em.agr.ca

TITLE: FUNGICIDE TREATMENTS FOR THE CONTROL OF FIELD AND POSTHARVEST FRUIT ROT IN RASPBERRIES IN 1999

MATERIALS: SWITCH 62.5 WG (cyprodinil +fludioxonil), ELEVATE 50WDG (fenhexamid), MAESTRO 80DF (captan)

METHODS: The study was done in a field at Agassiz, B.C. known to have fruit rot. Each plot consisted of one 4.25 m row of raspberries, cv. Willamette. There were 4 replicates and treatments were arranged in a randomized block design. Raspberries were planted in 1988. The weather in 1999 during blossoming was cooler and wetter than 1998. Weather became sunnier and warmer during harvest time. SWITCH, ELEVATE, MAESTRO AND MAESTRO + SWITCH were applied on May 25, June 2, June 10 and July 4. Treatments were applied with a hand-held boom attached to a carbon-dioxide-pressurized backpack sprayer at a pressure of 60 psi. The first pick did not occur until July 5, two weeks later than in 1998. Harvest continued until July 28. At each picking, marketable, rot and cull weights were recorded. Size index based on the gram weight of 50 berries was also recorded at each picking. A postharvest fruit rot trial was also set up. Fifteen randomly picked berries from the marketable yield were placed on styrofoam plates covered with damp paper towels. The plates were then covered with plastic wrap. Two sets of all treatments were made up. One set was left at ambient temperature and rots counted approximately 2 days later. The other set was put in cold storage at 2• C for approximately 6 days, then removed and left at ambient temperature and rots counted 2 days later. Three postharvest rots developed: *Botrytis cinerea, Rhizopus* sp. and *Cladosporium* sp. Data were analysed with the general linear models procedure (SAS institute, Cary, NC) and means were separated using the Duncan's Multiple Range Test.

RESULTS: Data are presented in Tables 1, and 2. No phytotoxic effects were observed in any of the treated plots. None of the fungicide treatments consistently affected *Rhizopus* sp. or *Cladosporium* sp.

CONCLUSIONS: Field rots were reduced by all fungicide treatments. In the storage trials *Botrytis cinerea* was reduced by all treatments in the ambient temperature setup. The results for *Rhizopus* sp. and *Cladosporium* sp. were not as consistent though ELEVATE and MAESTRO did reduce these rots on some of the setup dates. Berries were counted as having a particular rot as soon as any fungal growth was seen on the berries. In all cases the size of the growth on the check was always larger than on any of the fungicide treated berries.

Table 1. Marketable weight, rot weight and percentage field rot of raspberries.

Treatment	Rate (grams ai/ha)	Marketable Weight (grams/m^2)	Rot Weight (grams/m^2)	Size Index (grams/m^2)	% Rot
CHECK	-	2547.0 a*	483.3 a	136.5 a	3.2 a
SWITCH	625	3132.6 a	209.6 ab	141.7 a	1.3 b
ELEVATE	550	2913.0 a	228.7 ab	132.4 a	1.5 b
ELEVATE	850	2475.2 a	165.0 b	135.5 a	1.2 b
MAESTRO	2750	2327.8 a	167.3 b	135.3 a	1.3 b
ELEVATE + MAESTRO	550 + 2750	3221.2 a	243.4 ab	137.3 a	1.5 b

* These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 2. Percentage of berries infected by *Botrytis cinerea* after being stored at ambient temperature following harvest.

Treatment and Rate (g ai/ha)	July 5* July 12	July 8 July 10	July 12 July 15	July 14 July 16	July 21 July 19	July 23 July 26	July 26 July 28	July 28 July 30
CHECK	63.3 a**	66.7 a	73.3 a	28.3 a	60.0 a	85.0 a	61.7 a	21.7 a
SWITCH 625	32.5 b	23.5 c	50.8 abc	10.2 b	50.2 a	43.3 b	48.5 ab	4.2 b
ELEVATE 550	38.3 b	51.7 ab	31.7 c	10.0 b	41.7 ab	46.7 b	55.0 ab	5.0 b
ELEVATE 850	21.7 b	36.7 bc	45.0 bc	6.7 b	45.0 ab	50.0 b	43.3 b	3.3 b
MAESTRO 2750	31.7 b	33.3 bc	58.3 ab	5.0 b	41.7 ab	50.0 b	38.3 b	4.3 b
ELEVATE 550 +MAESTRO +2750	23.5 b	12.5 c	44.2 bc	0.0 b	21.3 b	52.3 b	53.0 ab	2.0 b

* First date: date raspberries collected; second date: date rots counted.

** These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 3. Percentage of berries infected by *Botrytis cinerea* after being held in cold storage then at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	July 5*, July 12, July 14	July 12, July 19, July 21
CHECK		93.3 a**	93.3 a
SWITCH	625	86.7 a	60.0 c
ELEVATE	550	78.3 a	85.0 ab
ELEVATE	850	75.0 a	80.0 ab
MAESTRO	2750	78.3 a	81.7 ab
ELEVATE + MAESTRO	550 + 2750	71.1 a	71.1 bc

* First date: date raspberries collected and put in cold storage; second date: date berries taken out of cold storage and placed at room temperature; third date: date rots counted.

** These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

1999 PMR REPORT # 75 **SECTION J - FRUIT - Diseases**
STUDY DATA BASE: 402-1252-9715

CROP: Strawberry, cv. Totem
PEST: *Botrytis cinerea, Rhizopus* sp., *Cladosporium* sp.

NAME AND AGENCY:
BROOKES V R
Agriculture & Agri-Food Canada
PARC, Agassiz, B.C. V0M 1A0
Tel: (604) 796-2221 Fax: (604) 796-0359 E-mail: brookesv@em.agr.ca

TITLE: FUNGICIDE TREATMENTS FOR THE CONTROL OF FIELD AND POSTHARVEST FRUIT ROT IN STRAWBERRIES IN 1999

MATERIALS: BRAVO 500 g/l (chlorothalonil), SWITCH (cyprodinil + fludioxonil), ELEVATE 50WDG (fenhexamid), MAESTRO 75 DF (captan)

METHODS: The study was done in a field in Agassiz, B.C. known to have fruit rot. Each plot consisted of one 5-m row of strawberries, cv. Totem. There were 4 replicates and treatments were arranged in a randomized block design. Strawberries were planted in 1997. The number of applications of a particular treatment was determined by the registered label, restrictions on the maximum amount of fungicide applied per year and seasonal weather conditions. The weather in the spring of 1999 was cooler and wetter than usual. Blossom development was delayed this year and the first pick did not occur until June 16, almost two weeks later than 1998. Weather during the picking season was also cool and wet. BRAVO was applied on October 22, 1998 and April 21 and May 5, 1999. ELEVATE, SWITCH, MAESTRO and MAESTRO + ELEVATE were applied on May 5, May 13, May 21, June 2 and June 13,1999. Treatments were applied with a hand-held boom attached to a carbon-dioxide-pressurized backpack sprayer at a pressure of 60 psi. Harvest began on June 16 and continued until July 6. At each picking, marketable, rot and cull weights were recorded. Size index based on the gram weight of 25 berries was also recorded at each picking. A postharvest fruit rot trial was as set up at each picking. Ten randomly picked berries from the marketable yield were placed on styrofoam plates covered with damp paper towels. The plates were then covered with plastic wrap. Berries were left at ambient temperature and rots counted 2 days later. Another trial was set up similar to the first except that the berries were put in cold storage at 2• C for approximately 6 days, then removed and left at ambient temperature and rots counted 2 days later. Three postharvest rots developed; *Botrytis cinerea, Rhizopus* sp. and *Cladosporium* sp. Data were analysed with the general linear models procedure (SAS institute, Cary, NC) and means were separated using the Duncan's Multiple Range Test.

RESULTS: Data are presented in Tables 1 to 5. No phytotoxic effects were observed in any of the treated plots.

CONCLUSIONS: Due to the cool, rainy weather the percentage of field rots for 1999 was much higher than in 1998, 30.7 % in the untreated check. Field rots were reduced by all fungicide treatments except BRAVO. Except for BRAVO, all the fungicides reduced postharvest *Botrytis* rot at least for some of the counts. The higher rate of ELEVATE, SWITCH and MAESTRO + ELEVATE were the most effective treatments at reducing postharvest *Botrytis* rot. None of the fungicides reduced *Rhizopus* sp. MAESTRO and MAESTRO + ELEVATE were the best treatments for reducing *Cladosporium* sp.

Table 1. Marketable weight, rot weight, size index and percentage field rot of strawberries.

Treatment	Rate (grams ai/ha)	No. of Applic.*	Marketable Weight (grams/m^2)	Rot Weight (grams/m^2)	Size Index (g/25 berries)	% Rot
CHECK	-	-	1427.0 a*	729.2 a	281.6 a	30.7 a
BRAVO**	1750	3	1694.6 a	781.0 a	302.1 a	29.9 a
ELEVATE	550	5	2068.2 a	459.8 bc	305.4 a	16.0 b
ELEVATE	850	5	2433.0 a	511.0 b	325.2 a	17.0 b
SWITCH	625	5	2015.6 a	275.4 c	316.8 a	10.2 b
MAESTRO	2750	5	2451.4 a	410.8 bc	304.5 a	13.5 b
ELEVATE + MAESTRO	550 + 2750	5	2126.4 a	307.8 bc	305.3 a	10.9 b

* Number of applications. These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

** BRAVO applications, one in the fall, 1998 and two in spring, 1999. ELEVATE, SWITCH and MAESTRO applications in the spring, 1999.

Table 2. Percentage of berries infected by *Botrytis cinerea* after being stored at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	No. of appn*	Date strawberries collected					
			36692	36697	36699	36704	36708	36712
CHECK	-	-	80.0 a**	75.0 a	100.0 a	42.5 ab	47.5 a	60.0 a
BRAVO	1750	3	57.5 ab	70.0 ab	100.0 a	60.0 a	50.0 a	57.5 a
ELEVATE	550	5	37.5 b	62.5 ab	100.0 a	22.5 ab	12.5 b	47.5 a
ELEVATE	850	5	40.0 b	45.0 b	95.0 a	20.0 b	7.5 b	45.0 a
SWITCH	625	5	32.5 b	42.5 b	52.5 b	15.0 b	5.0 b	52.5 a
MAESTRO	2750	5	37.5 b	45.0 b	95.0 a	22.5 ab	27.5 ab	35.0 a
ELEVATE +MAESTRO	550 +2750	5	35.0 b	47.0 b	87.5 a	10.0 b	7.5 b	37.5 a

* No of Appn = number of applications

** These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 3. Percentage of berries infected by *Cladosporium* sp. after being stored at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	No. of appn*	Date strawberries collected					
			36326	36331	36333	36338	36342	36712
CHECK	-	-	25.0 a**	72.5 a	75.0 ab	7.5 a	50.0 ab	22.5 ab
BRAVO	1750	3	45.0 a	40.0 bc	70.0 abc	7.5 a	55.0 a	12.5 ab
ELEVATE	550	5	47.5 a	50.0 ab	92.5 a	12.5 a	37.5 ab	25.0 a
ELEVATE	850	5	45.0 a	32.5 bcd	95.0 a	10.0 a	55.0 a	17.5 ab
SWITCH	625	5	45.0 a	47.5 ab	60.0 bcd	5.0 a	32.5 ab	10.0 ab
MAESTRO	2750	5	37.5 a	15.0 cd	45.0 cd	2.5 a	35.0 ab	17.5 ab
ELEVATE +MAESTRO	550 +2750	5	30.0 a	12.5 d	40.0 d	5.0 a	20.0 b	5.0 b

* No of Appn = number of applications

** These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 4. Percentage of berries infected by *Botrytis cinerea* after being held in cold storage, then stored at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	Number. of applications	Date strawberries collected	
			36708	36712
CHECK	-	-	63.3 a*	75.0 a
BRAVO	1750	3	62.5 a	60.0 a
ELEVATE	550	5	20.0 c	55.0 ab
ELEVATE	850	5	32.5 bc	26.7 b
SWITCH	625	5	25.0 c	60.0 a
MAESTRO	2750	5	50.0 ab	45.0 ab
ELEVATE + MAESTRO	550 + 2750	5	25.0 c	53.3 ab

* These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P<0.05).

Table 5. Percentage of berries infected by *Cladosporium* sp. after being held in cold storage, then stored at ambient temperature following harvest.

Treatment	Rate (g ai/ha)	Number of applications	Date strawberries collected	
			36708	36732
CHECK	-	-	16.7 a*	10.0 a
BRAVO	1750	3	17.5 a	20.0 a
ELEVATE	550	5	7.5 a	15.0 a
ELEVATE	850	5	20.0 a	6.7 a
SWITCH	625	5	30.0 a	16.7 a
MAESTRO	2750	5	5.0 a	0.0 a
ELEVATE + MAESTRO	550 + 2750	5	2.5 a	3.3 a

* These values are the means of four replications. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P<0.05).

1999 PMR REPORT # 76 **SECTION J: FRUIT - Diseases**
ICAR:8888030

CROP: Sweet cherry (*Prunus avium)*
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

NAME AND AGENCY:
SHOLBERG P L, and LASHUK, L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: USE OF VANGARD FOR CONTROL OF BROWN ROT OF SWEET CHERRIES IN 1998

MATERIALS: VANGARD 75 WG (cyprodinil), ROVRAL 50 WP (iprodione)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. in an orchard block consisting of 15 mature (approx. 40 year-old) sweet cherry trees. The experimental design was a randomized complete block with treatments replicated five times on single tree replicates. The treatments were applied until run-off with a handgun operated at 3000 kPa on April 22 (full bloom), May 1 (petal fall), June 25 (14 days before harvest) and July 9 (1 day before harvest). Number of blighted blossoms were counted on May 11 by visually examining each tree for withered blossoms. Blossom blight was also evaluated on shoots from trees sprayed in the orchard and placed in the greenhouse and misted with 2.5×10^4 conidia/mL of *Monilinia fructicola* on April 24. Number of blighted blossoms per 25 blossoms was recorded on April 30. Fruit brown rot was assessed at harvest on July 10 by evaluating 200 fruit per tree for brown rot. Weight of brown rotted fruit and total weight were also recorded at this time. Postharvest brown rot was evaluated by placing 25 cherries in a humid container at 20• C for 6 days and recording number of decayed fruit. These values were converted to percent infected fruit by number and weight and the arcsin transformed values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range test was used for multiple comparison of means and the detransformed means were reported.

RESULTS: Blossom blight did not occur in the orchard but did in the greenhouse. Blighted blossoms numbered 16, and 9, for the control, and VANGARD, treatments, respectively. The Chi-square value was 3.92 indicating that there was a significant difference between treatments (P• 0.05). VANGARD did not significantly reduce fruit brown rot at harvest or when stored for 6 days.

CONCLUSIONS: VANGARD applied at the label rate for blossom blight was effective in reducing number of blighted cherry blossoms in this trial. At half the recommended label rate it was not effective in reducing fruit brown rot although the trend in the VANGARD treated fruit was for less brown rot than for the control. This particular trial experienced severe brown rot as indicated by almost 90% of the fruit with brown rot at harvest. The disease was probably spread by fruit flies that were not controlled by insecticides.

Table 1. Percent fruit brown rot on cherries sprayed with VANGARD or ROVRAL.

Treatment	Rate/100L	Infected Fruit (%) (Based on number)	Infected Fruit (%) (Based on weight)	No. Infected Fruit (%) Postharvest
CONTROL	---	88.2 a	85.1 a	86.4 a
ROVRAL	43.2 g	66.9 b	57.1 b	44.0 b
VANGARD	22.3 g	83.6 ab	69.7 ab	58.1 ab
ANOVA MODEL Pr>F		0.093	0.022	0.069
ANOVA TRT Pr>F		0.075	0.027	0.030

* These values are means of five replications. Raw data were arcsin transformed before ANOVA and the detransformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

1999 PMR REPORT # 77 **SECTION J: FRUIT - Diseases**
ICAR:8888030

CROP: Sweet cherry (*Prunus avium)*
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

NAME AND AGENCY:
SHOLBERG P L, and LASHUK, L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 **Fax:** (250) 494-0755 **Email:** Sholbergp@em.agr.ca

TITLE: **USE OF ABOUND FOR CONTROL OF BROWN ROT OF SWEET CHERRIES IN 1998**

MATERIALS: ABOUND FLOWABLE (22.9% azoxystrobin), ROVRAL 50 WP (iprodione)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. in an orchard block consisting of 15 mature (approx. 40 year-old) sweet cherry trees. The experimental design was a randomized complete block with treatments replicated five times on single tree replicates. The treatments were applied until run-off with a handgun operated at 3000 kPa on April 22 (full bloom), May 1 (petal fall), June 25 (14 days before harvest) and July 9 (1 day before harvest). An extra spray of ROVRAL 50 WP at label rate was applied on May 29 to trees in the ABOUND trial. Number of blighted blossoms were counted on May 11 by visually examining each tree for withered blossoms. Blossom blight was also evaluated on shoots from trees sprayed in the orchard and placed in the greenhouse and misted with 2.5×10^4 conidia/mL of *Monilinia fructicola* on April 24. Number of blighted blossoms per 25 blossoms was recorded on April 30. Fruit brown rot was assessed at harvest on July 10 by evaluating 200 fruit per tree for brown rot. Weight of brown rotted fruit and total weight were also recorded at this time. These values were converted to percent infected fruit by number and weight and the arcsin transformed values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range test was used for multiple comparison of means and the detransformed means were reported.

RESULTS: Blossom blight did not occur in the orchard but did in the greenhouse. Blighted blossoms numbered 16, 0, and 3, for the control, ABOUND, and ROVRAL treatments, respectively. The Chi-square value was 30.7 indicating that there was a significant difference between treatments (P• 0.001). Due to the extremely high levels of brown rot in this trial it was possible to show that ABOUND was more effective than ROVRAL and ROVRAL was more effective than the CHECK (Table 1). ABOUND reduced decay from 88.2 to 32.3%.

CONCLUSIONS: Under the conditions of this trial ABOUND significantly reduced blossom blight and fruit brown rot. ABOUND was significantly better than ROVRAL in controlling fruit brown rot. It should be noted that an extra ROVRAL spray was applied to the ABOUND block on May 29, 42 days before harvest as an antiresistance strategy. It is unlikely that this extra cover spray would have had a noticeable effect on the final outcome of the trial.

Table 1. Percent fruit brown rot at harvest on cherries sprayed with ABOUND or ROVRAL

Treatment	Rate of Product /100L	% Infected Fruit based on no.	% Infected Fruit based on wt.
CHECK	----	88.2 a*	74.8 a
ROVRAL	90 g	66.1 b	56.3 b
ABOUND**	24 mL	32.3 c	34.3 c
ANOVA Pr>F		0.008	0.005

* These values are means of five replications. Raw data were arcsin transformed before ANOVA and the detransformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** ROVRAL at the 90 g rate was applied to the ABOUND block on May 29 but was not applied to the ROVRAL block.

1999 PMR REPORT # 78 **SECTION J: FRUIT - Diseases**
ICAR:8888030

CROP: Sweet cherry (*Prunus avium)*
PEST: Brown rot, *Monilinia fructicola* (Wint.) Honey

NAME AND AGENCY:
SHOLBERG P L, and LASHUK, L C
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre Summerland, British Columbia V0H 1Z0
Tel: (250) 494-6383 Fax: (250) 494-0755 Email: Sholbergp@em.agr.ca

TITLE: USE OF ELEVATE FOR CONTROL OF BROWN ROT OF SWEET CHERRIES IN 1998

MATERIALS: ELEVATE 50 WDG (fenhexamid), ROVRAL 50 WP (iprodione)

METHODS: The trial was conducted at the Pacific Agri-Food Research Centre, Summerland, B.C. in an orchard block consisting of 20 mature (approx. 40 year-old) sweet cherry trees. The experimental design was a randomized complete block with treatments replicated five times on single tree replicates. The treatments were applied until run-off with a handgun operated at 3000 kPa on April 22 (full bloom), May 1 (petal fall), June 25 (14 days before harvest) and July 9 (1 day before harvest). Number of blighted blossoms were counted on May 11 by visually examining each tree for withered blossoms. Blossom blight was also evaluated on shoots from trees sprayed in the orchard and placed in the greenhouse and misted with 2.5 x 10^4 conidia/mL of *Monilinia fructicola* on April 24. Number of blighted blossoms per 25 blossoms was recorded on April 30. Fruit brown rot was assessed at harvest on July 10 by evaluating 200 fruit per tree for brown rot. Weight of brown rotted fruit and total weight were also recorded at this time. In addition 25 fruit that appeared to be free of brown rot at harvest were placed in a humid atmosphere and incubated for 3 days at 20• C when rot was recorded. These values were converted to percent infected fruit by number and weight and the arcsin transformed values were subjected to analysis of variance with the General Linear Models Procedure (SAS Institute, Cary, NC). The Duncan's Multiple Range test was used for multiple comparison of means and the detransformed means were reported.

RESULTS: Blossom blight did not occur in the orchard but did in the greenhouse. Blighted blossoms numbered 16, 15, 15, and 3, for the control, ELEVATE low rate, ELEVATE high rate, and ROVRAL treatments, respectively. ELEVATE at the low rate significantly reduced the number of cherries in the tree with brown rot (Table 1). It was as effective as the ROVRAL standard treatment. On the other hand the high rate of ELEVATE did not significantly reduce brown rot.

CONCLUSIONS: ELEVATE does not appear to be an effective material for controlling cherry blossom blight but should be tested more extensively before making any final decisions. ELEVATE at the low rate used in this trial was as effective as the ROVRAL standard treatment in reducing brown rot of cherry fruit in the orchard. Brown rot disease pressure was extremely high due to uncontrolled fruit fly damage. It is not known why the slightly higher rate of ELEVATE was not effective. Perhaps the higher rate of

ELEVATE made the cherries more attractive to fruit flies leading to a higher percent of infection and disease. ELEVATE was as effective as ROVRAL in preventing postharvest brown rot.

Table 1. Percent brown rot on cherries sprayed with ELEVATE and ROVRAL

Treatment	Rate of Product /100L	No. of Infected Fruit (%)	Wt. of Infected Fruit (%)	Fruit Infected Postharvest (%)
CHECK	----	88.2 a*	74.8 a	86.4 a
ELEVATE	76.0 g	87.3 a	76.5 a	61.9 ab
ROVRAL	90.0 g	66.1 b	56.3 b	42.6 b
ELEVATE	67.7 g	61.5 b	52.9 b	57.6 b
ANOVA Pr > F		0.011	0.003	0.023

* These values are means of five replications. Raw data were arcsin transformed before ANOVA and the detransformed means are presented here. Numbers within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

END OF SECTION J (Report #s 66 - 78; Pages 175-207).

SECTION K: VEGETABLES AND SPECIAL CROPS/ LÉGUMES ET CULTURES SPÉCIALES

REPORTS /RAPPORTS # 79 - 89

PAGES: 208 - 238

EDITOR **Dr. Ray F. Cerkauskas**

Agriculture and Agri-Food Canada
Greenhouse and Processing Crops
Research Centre, Highway 18
Harrow, Ontario N0R 1G0

Email: cerkauskasr@em.agr.ca
Tel: (519) 738-2251
Fax: (519) 738-2929

1999 PMR REPORT # 79 SECTION K: VEGETABLES and SPECIAL CROPS - DISEASES
ICAR: 206003

CROP: White cabbage (*Brassica oleracea* var. *capitata* L.)
Cauliflower(*Brassica oleracea* var. *botrytis* L. Minute Man)
PEST: Clubroot, *Plasmodiophora brassicae*

NAME AND AGENCY:
McDONALD M R and ROBERTS L A
Muck Crops Research Station, 1125 Woodchoppers Lane
RR #1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546

TITLE: MANAGEMENT OF CLUBROOT OF CRUCIFERS, 1999

MATERIALS: PERKLA (50% calcium oxide, 14% cyanamide, 2% nitrate), AGRAL 90 (150 mg/m^3 isobutanol, 15 mg/m^3 nonyl phenol ethoxylates), LIME (dolomitic, 22% calcium, 12% magnesium)

METHODS: One Muck Crop Research Station (MCRS) site (site 1, organic muck soil, pH 6.8) and one commercial field site (site 2, mineral soil, pH 6.3) were established in the Holland Marsh, Ontario. One commercial field site (site 3, mineral soil, pH 7.7) was established north of the Holland Marsh in the Township of West Gwillimbury, Ontario. Clubroot is endemic at all sites. The location and size of site 3 was determined with the aid of a Global Positioning System. Site 1 consisted of six treatments while sites 2, and 3, had four treatments each. A randomized complete block arrangement was used. Each replicate consisted of eight beds 5 m in length. Sites 1 and 2 were transplanted (3 heads per meter with 2 rows per bed) with white cabbage (*Brassica oleracea* var. *capitata* L.) Site 3 was transplanted (3 heads per meter with 2 rows per bed) with cauliflower (*Brassica oleracea* var. *botrytis* L. Minute Man). At each site, account was taken of the quantity of nitrogen provided by calcium cyanamide (PERLKA) and appropriate rates of standard nitrogen fertilizer were applied to raise the total amount of nitrogen in all treatments to similar levels. All treatments (except drench) were broadcast by hand on to measured areas to ensure uniformity of application and were pre-plant incorporated to a depth of 5-10 cm. Three rates of PERLKA were applied at 1000 kg/ha, 500 kg/ha and 333 kg/ha (in 20 cm bands) at site 1. At sites 2 and 3, PERLKA was applied at 1000 kg/ha. A drench treatment was applied by hand around the base of the plants approximately three weeks after transplanting of 1.0ml AGRAL 90/200ml water at all sites. Dolomitic lime was also pre-plant incorporated at 4.9 tons/ha. An untreated check was also included. Soil samples were taken for analysis when the fertilizers were applied. Relative soil moisture was measured and recorded for each site using the microwave drying method. The air temperatures were above the long term (10 year) average for June, July and September and below average for August. Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71.0 mm) and August (78.8 mm) and above average for September (137.5 mm). Sites 1 and 3 were irrigated throughout the growing season to offset the lack of natural precipitation. Site 2 was not irrigated. Weed germination counts of 1 m^2 were taken on 22 Jun and 29 Jun for site 1. For site 2, weed counts were taken on 24 Jun and 6 Jul. For site 3, weed counts were taken on 15 Jun and 21 Jul. At harvest a sample of approximately 30 plants from each repetition from all sites were graded for clubroot incidence and disease severity. Disease severity was assessed using a scale from zero to three: zero - no clubbing, one - < 25 % of root system clubbed, two - 25 to 50 % of root system clubbed and three - > 50 % root system clubbed (Humpherson-Jones, 1989). The disease severity assessment scale was then multiplied by a factor (zero x 0, one x 1, two x 2 and three x 4) and summed for disease severity. Head weights were recorded for site 1. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V. 4.1.

RESULTS: As presented in Tables 1, 2, and 3.

CONCLUSIONS: At site 3, the AGRAL 90 drench significantly reduced clubroot incidence compared to that of the check (Table 2). At sites 1 and 3, the LIME treatment had the highest disease incidence. The PERLKA and AGRAL 90 treatments at site 3 significantly reduced the disease severity compared to the LIME treatment. The treatments had no significant effects on weed germination (Table 1). The treatments had no significant effects on yield (Table 3). No phytotoxicity was noted during the trials, on any of the treatments. The long term total rainfall average indicates that this was an extremely dry summer. The soil moisture content at site 1, when fertilized was 247.4 % (w/w). The soil moisture content at site 2, when fertilized was 30.1 % (w/w) and 13.3 % (w/w) at site 3. According to the manufacturer, high soil moisture is essential for chemical decomposition. Site 2 was not irrigated throughout the growing season. Since this season was a hot dry one, the PERLKA may not have functioned to it's true potential at any of the sites.

* Partial funding for this project was made available by Perform Trading Inc. and The Agriculture Adaptation Council with the support of the Ontario Fruit and Vegetable Growers Association.

Table 1. Control of weeds in crucifer crops at 1 MCRS site (S1) and 2 commercial field sites (S2 and S3), 1999.

Treatment	Rate	Weed Population (m^2) **					
		S1		S2		S3	
		22 Jun	29 Jun	24 Jun	6 Jul	15 Jun	21 Jul
Check		284 ns*	231 ns*	37.3 ns*	12.3 ns*	6.0 ns*	12.5 ns*
LIME	4.9 ton/ha	240	300	45	11.8	1.5	7.8
AGRAL 90	1.0 ml/200 ml H_20	328	290	23.8	9.5	2.8	5
PERLKA	1000 kg/ha	190	271	27.8	10.5	0.5	1.5
PERLKA	500 kg/ha	216	307	----	----	----	----
PERLKA	333 kg/ha	320	424	----	----	----	----

* ns - no significant differences (P=0.05, Fisher's Protected LSD Test) were found among the treatments.

** Weeds present in total number are those of chickweed, common groundsel, oakleaf goosefoot, mapleleaf goosefoot, portulaca, redroot pigweed, ladies thumb, lambs quarters, sow thistle, shepard's purse, and biennial wormwood.

Table 2. Clubroot incidence (%) and severity from approximately 30 plants from 1 MCRS site (S1) and 2 commercial field sites (S2 and S3) at harvest, in 1999.

		Clubroot Incidence			Clubroot Severity		
Treatment	Rate	S1	S2	S3	S1	S2	S3
Check		65.1 ns*	100.0 ns*	87.4 a**	41.0 ns*	120.5 ns*	51.0 b**
LIME	4.9 ton/ha	89.2	100.0	88.3 a	68.3	114.8	69.0 a
AGRAL 90	1.0 ml/200 ml H_2O	76.7	100.0	68.6 b	47.0	100.5	31.0 c
PERLKA	1000 kg/ha	61.7	100.0	81.0 ab	34.8	101.3	40.0 bc
PERLKA	500 kg/ha	60.8	-----	-----	32.5	-----	-----
PERLKA	333 kg/ha	63.3	-----	-----	32.3	-----	-----

* ns - no significant treatment effects were observed.

** Numbers in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

Table 3. Harvest head weights from 30 plants from site 1 (MCRS), 1999.

Treatment	Rate	Yield (kg)
Check		116.7 ns*
LIME	4.9 ton/ha	113.9
AGRAL 90	1.0 ml/200 ml H_2O	116.9
PERLKA	1000 kg/ha	120.9
PERLKA	500 kg/ha	118.8
PERLKA	333 kg/ha	118.2

* ns - no significant treatment effects were observed.

1999 PMR REPORT # 80 **SECTION K: VEGETABLES AND SPECIAL CROPS - DISEASE**
STUDY DATA BASE: 402-1252-9715

CROP: Cucumber, *Cucumis sativus* L., Cvs. Corona, Enigma
PEST: *Pythium aphanidermatum* (Edson) Fitzp.

NAME AND AGENCY:
Brookes V R
Agriculture and Agri- Food Canada, PARC,
Agassiz, B.C. V0M 1A0
Tel: (604) 796-2221 x 228 Fax: (604) 796-0359 E-mail: brookesv@em.agr.ca.

TITLE: ALIETTE TREATMENTS FOR CONTROL OF *PYTHIUM APHANIDERMATUM* IN GREENHOUSE CUCUMBERS

MATERIALS: ALIETTE (fosetyl-al 80WP)

METHODS: A study was set up to compare several rates of ALIETTE for crop tolerance and efficacy on greenhouse cucumber seedlings inoculated with *Pythium aphanidermatum* (2500 zoospores/ml) or uninoculated. All trials took place in a glass greenhouse in Agassiz, B.C. between May and October, 1998. Cucumber plants (cv. Corona or Enigma) were seeded either in rockwool cubes and covered with vermiculite or in a 85% peat/15% perlite mixture (Table 1). ALIETTE treatments were applied over the cucumber seedlings with excess fungicide going into the rockwool cubes or peat/perlite mixture. Treatments were arranged in a randomized complete block design. In trials 1 and 2, plants were inoculated with the fungus, then treated with ALIETTE whereas in trial 4, plants were inoculated after being treated with ALIETTE. In trials 3, 5 and 6 only uninoculated plants were used. Depending on the trial, rates of ALIETTE varied between 0.15 and 1.9 g product/plant and water volumes varied from 50 to 250 ml. Plant height and fresh weight were recorded 20 to 36 days after seeding. The number of leaves/plant was recorded in trial 1. There were between 2 and 7 replications in each trial. Data were analyzed with the general linear models procedure (SAS Institute, Cary, NC) and means were separated using the Duncans' Multiple Range Test. Plants which died from *P. aphanidermatum* were treated as missing data in the analyses.

RESULTS: **Trial 1.** Data are presented in Table 2. Plants receiving the 1.9 g rate wilted following application, especially as temperature and light levels increased. There was a significant reduction in plant height, leaf number and plant weight in all the ALIETTE treatments and the *Pythium*-inoculated check. The highest rate of ALIETTE had the greatest growth reduction.

Trial 2. Data are presented in Table 3. Plant wilting in the 0.8 and 1.0 g product/plant treatments occurred several hours after the ALIETTE application. The untreated, inoculated control succumbed to *Pythium*: 5 and 14 days after inoculation, two and five replicates respectively were dead. One of the plants treated with the lowest rate (0.15 g prod/plant in 50 ml of water) also succumbed to *Pythium.* Plant heights were reduced by all ALIETTE treatments 4 days after treatment. The greater the ALIETTE rate the greater the reduction.

Trial 3. Data are presented in Table 4. Within 30 minutes there was severe wilting in both treatments volumes of the 1.0 g product/plant rate. After 24 hr, wilting was observed in both the 0.6 and 1.0 g product/plant treatments. Cucumber growth was detrimentally affected by ALIETTE and the greater the ALIETTE rate the greater the effect. There was no difference between the two water volumes.

Trial 4. Data are presented in Table 5. The 0.8 g product/plant treatment was wilting the day after treatment. There was no reduction in plant heights taken 5 days after treatment in the 0.15 g product/plant rate. Growth was reduced by all other rates.

Trial 5. Data are presented in Table 6. There was no wilting following treatment with ALIETTE on cucumbers growing in the peat/perlite mixture. Growth did not appear to be affected by the ALIETTE treatments.

Trial 6. There was no wilting in any of treatments when cucumbers were grown in a peat/perlite mixture.

CONCLUSIONS: There appears to be poor cucumber tolerance to ALIETTE treatments when plants are grown in rockwool cubes. The 0.15 g product/plant rate was tolerated in one trial. However, in an inoculated trial, this rate did not prevent development of *P. aphanidermatum.* Water volumes were also varied from 25 to 200 ml per plant. Variance in water volume did not affect crop tolerance. Good crop tolerance was observed when ALIETTE was applied to greenhouse cucumbers grown in a peat/perlite mixture. This mixture was used because of the tolerance of greenhouse lettuce to ALIETTE treatments when grown in peat blocks. Greenhouse lettuce is still seeded into peat blocks, however the standard practice for cucumbers has changed and now greenhouse cucumbers are usually started in small rockwool cubes. Data presented here suggest that ALIETTE should not be used for *Pythium* control in greenhouse cucumbers if the seedlings are grown in rockwool cubes.

Table 1. Details of each of the 6 trials investigating crop tolerance and efficacy of ALIETTE on greenhouse cucumber seedlings inoculated with *Pythium aphanidermatum* or uninoculated conducted in Agassiz, BC, in 1998.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Cucumber cv.	Corona	Enigma	Enigma	Enigma	Corona	Corona
Growing media	rockwool vermiculite	rockwool vermiculite	rockwool vermiculite	rockwool vermiculite	peat/ perlite	peat/ perlite
Seeding date	36672	36700	36700	36700	Aug. 10	Sept. 3
Inoculation *	19	15	n/a	16	n/a	n/a
Treatment *	21	16	14	15	17	19
ALIETTE rates (g prod/plant)	0.6, 0.8, 1.0, 1.2, 1.9	0.15, 0.3, 0.6, 0.8, 1.0	0.15, 0.3, 0.6, 1.0	0.15, 0.3, 0.6, 0.8	0.2, 0.6, 0.8, 1.0, 1.2, 1.5, 1.9	0.2, 0.6, 0.8, 1.0, 1.2, 1.5, 1.9
Water volume	250	50, 100	25, 100	100	200	200
No. of replicates	6	7	2	3	5	6
Plant height *	28	20, 29	20	20, 28	20	-
No. of leaves *	28	-	-	-	-	-
Fresh weight *	28	29	36	36	-	-

* Days after seeding.

Table 2. Plant height, leaf number and fresh weight of cucumber 'Corona' seedlings inoculated and uninoculated with *P. aphanidermatum* treated with ALIETTE at Agassiz, B.C. in June, 1998, Trial 1.

Treatments*	Rate (g prod/plant in 250 ml water)	Plant height (cm)**	Leaf number /plant	Plant fresh weight (g)
Untreated + u	-	54.2 a	5.7 a	40.2 a
Untreated + i	-	42.2 cde	5.0 bc	20.2 def
ALIETTE + u	0.6	45.2 bc	5.0 bc	27.0 bc
ALIETTE + i	0.6	46.1 b	5.0 bc	27.5 b
ALIETTE + u	0.8	44.2 bc	4.8 bc	21.3 de
ALIETTE + i	0.8	46.0 b	5.0 bc	23.2 bcd
ALIETTE + u	1	43.2 bcd	5.2 b	22.9 cd
ALIETTE + i	1	40.0 def	4.7 cd	17.6 efg
ALIETTE + u	1.2	37.6 f	4.8 bc	16.8 efg
ALIETTE + i	1.2	40.3 def	5.0 bc	20.9 de
ALIETTE + u	1.9	39.2 ef	4.3 d	16.0 fg
ALIETTE + i	1.9	32.5 g	3.8 e	13.1 g

* u = uninoculated; i = inoculated.

** Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 3. Plant height and fresh weight of cucumber 'Enigma' seedlings inoculated and uninoculated with *P. aphanidermatum* treated with ALIETTE in two water volumes at Agassiz, B.C. in July, 1998, Trial 2.

Treatments*	Rate (g prod /plant)	Water volume (ml)	Plant height (cm)**		Plant weight (g)
			20 days after seeding	29 days after seeding	29 days after seeding
Untreated + u	-	-	29.5 a	65.9 a	77.0 a
Untreated + i	-	-	27.8 a	60.4 ab	70.4 ab
ALIETTE + u	0.15	50	26.0 b	61.5 a	68.7 ab
ALIETTE + i	0.15	50	26.0 b	62.6 a	54.8 cd
ALIETTE + u	0.15	100	25.6 bc	62.5 a	63.3 bc
ALIETTE + i	0.15	100	25.5 bc	52.2 bcd	40.2 ef
ALIETTE + u	0.3	50	23.0 d	57.2 abc	48.6 de
ALIETTE + i	0.3	50	23.5 cd	50.2 cd	38.4 efg
ALIETTE + u	0.3	100	21.5 de	50.1 cd	38.8 efg
ALIETTE + i	0.3	100	23.5 cd	46.7 de	34.2 fgh
ALIETTE + u	0.6	50	21.4 de	39.8 ef	23.5 hij
ALIETTE + u	0.6	100	21.7 de	37.9 f	27.4 ghi
ALIETTE + i	0.6	100	18.9 f	26.1 g	11.0 jk
ALIETTE + u	0.8	50	20.1 ef	29.6 g	16.3 ijk
ALIETTE + i	0.8	50	21.0 def	25.1 g	11.1 jk
ALIETTE + u	0.8	100	19.3 ef	27.8 g	16.2 ijk
ALIETTE + i	0.8	100	19.7 ef	21.9 g	8.6 k
ALIETTE + u	1	50	19.6 ef	26.4 g	11.1 jk
ALIETTE + i	1	50	19.5 ef	21.6 g	8.1 k
ALIETTE + u	1	100	20.4 ef	29.1 g	10.8 jk
ALIETTE + i	1	100	19.5 ef	22.4 g	8.6 k

* u = uninoculated; i = inoculated.

** Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

Table 4. Plant height and fresh weight of cucumber 'Enigma' seedlings grown in rockwool cubes and treated with ALIETTE at Agassiz, B.C. in July, 1998, Trial 3.

Treatment	Rate (g prod/plant)	Water volume (ml)	Plant height (cm)*	Plant fresh weight (g)
untreated	-	-	28.0 a	230.9 a
ALIETTE	0.15	25	23.0 b	162.0 bc
ALIETTE	0.15	100	21.3 bc	170.1 b
ALIETTE	0.3	25	18.1 cd	103.6 cd
ALIETTE	0.3	100	17.9 cd	94.5 d
ALIETTE	0.6	25	16.9 d	74.0 de
ALIETTE	0.6	100	16.8 d	47.0 de
ALIETTE	1	25	16.1 d	23.2 e
ALIETTE	1	100	16.2 d	14.6 e

* Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P<0.05).

Table 5. Height and fresh weight of cucumber 'Enigma' seedlings inoculated and uninoculated with *P. aphanidermatum* treated with ALIETTE at Agassiz, B.C. in July, 1998, Trial 4.

Treatments*	Rate (g prod/plant in 100 ml water)	Plant height (July 14) (cm)**	Plant height (July 22) (cm)	Plant fresh weight (July 30) (g)
Untreated + u	-	22.9 a	46.6 a	210.5 a
Untreated + i	-	22.7 a	30.5 bc	135.8 abc
ALIETTE + u	0.15	21.5 a	43.0 ab	191.3 ab
ALIETTE + i	0.15	19.5 ab	42.0 ab	170.2 ab
ALIETTE + u	0.3	16.8 bc	30.3 bc	111.4 cd
ALIETTE + i	0.3	15.6 bc	21.4 c	40.9 d
ALIETTE + u	0.6	14.6 c	17.5 c	30.7 d
ALIETTE + i	0.6	16.1 bc	22.5 c	65.5 cd
ALIETTE + i	0.8	16.0 bc	20.0 c	53.0 d

* u = uninoculated; i = inoculated.

** Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P<0.05).

Table 6. Plant height of cucumber 'Corona' seedlings grown in a peat mix and treated with ALIETTE at Agassiz, B.C. in August, 1998. All treatments were applied in 200 ml of water per plant, Trial 5.

Treatment	Rate (g prod/plant)	Plant height (cm)*
Untreated	-	17.8 abc
ALIETTE	0.2	19.5 ab
ALIETTE	0.4	21.5 a
ALIETTE	0.6	18.2 abc
ALIETTE	0.8	15.3 c
ALIETTE	1	20.5 a
ALIETTE	1.2	15.9 bc
ALIETTE	1.5	18.8 abc
ALIETTE	1.9	18.4 abc

* Means with a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test ($P<0.05$).

1999 PMR REPORT # 81 SECTION K: VEGETABLES and SPECIAL CROPS - Diseases
ICAR: 93000482

CROP: Lettuce (*Lactuca sativa* L.)
PEST: Downy Mildew, *Bremia lactucae* Regel.

NAME AND AGENCY:
KUSHALAPPA, A C
McGill University, Plant Science Department
Ste. Anne de Bellevue, Quebec H9X 3V9
Tel: (514)398-7851 ext. 7867 Fax: (514)398-7897 Email: kushalappa@macdonald.mcgill.ca

TITLE: BREMCAST: A SYSTEM TO FORECAST DOWNY MILDEW OF LETTUCE (*Bremia lactucae*).

MATERIALS: A software, written in Visual BASIC for the windows environment, to forecast risk levels (disease severity values) of downy mildew in lettuce.

METHODS:

Software - BREMCAST

BREMCAST - (V2) (**BREM**ia fore**CAST**) is a user-friendly software written in Visual Basic, for the Windows environment, to forecast downy mildew of lettuce (*Bremia lactucae*). The software was developed based on information extracted mainly from research conducted by Kushalappa and coworkers (1-3), and also from the published work of others (4,5). Various components of the forecasting system have been tested under field conditions. BREMCAST forecasts/calculates daily infection values (INFV), daily sporulation values (SPOV), daily Disease Severity Values (DSV) and Cumulative Disease Severity Values (CDSV) from planting until harvest based on various host, pathogen/disease and environmental parameters influencing downy mildew development in the field. The daily input data on weather and presence of disease, for a given lettuce field must be provided by the user to predict INFV, SPOV, DSV and CDSVs for his/her field. The DSVs and CDSVs indicate predicted disease risk, and could be used to make intelligent decisions to manage downy mildew of lettuce. User's experience on the efficiency of BREMCAST output to time fungicide applications under commercial conditions is highly appreciated.

Technical description:

BREMCAST calculates Disease Severity Values (DSV) for each day of data input, since the date of planting of lettuce. The DSVs are calculated from Inoculum Source (INOS), Sporulation Values, including spore release and survival (SPOV), and Infection Values (INFV). The INOS is determined based on the presence of disease in the field. The daily SPOV is calculated from the average night time relative humidity and/or duration of night time leaf wetness and temperature. The spores are considered released in the morning hours and available for infection, or survived for the next day depending on the hours of solar radiation. The daily INFVs are calculated from the duration of morning leaf wetness and temperature (based on electronic data logger with grid and vaisala sensors - CR-10).

Computer requirement:

To run the software you need an IBM compatible computer with WINDOWS 95 or higher. To run the program install BREMCAST in the hard disc using the instruction provided or run from a CD or disk.

Validation under field conditions:
Lettuce seedlings cv Ithaca produced in plastic trays, in growth chamber at 15 C, were inoculated at the 3rd leaf stage with a spore suspension ($3x10^4$ spores/ml) *B. lactucae* produced in plants grown in growth chambers and transplanted in the field (Horticultural farm, McGill Univ.), consisting of ten rows of 4 m, with 0.4 m spacing between and within rows. Plants produced in pots (2-3 true leaf stage) were placed within this plot at 1800 h, removed next day at 0800 h or after the end of the wet period if the leaf surface was wet based on visual observation. Plants were kept in a growth chamber for 7 d and the presence/absence of downy mildew was recorded. Microclimatic data on temperature, duration of leaf wetness and RH were collected using electronic instruments connected to a data logger (CR-10, Campbell Canada). These data were entered into BREMCAST to forecast downy mildew. This study was conducted on 10 different days. Downy mildew was predicted as severity value 0, 1, 2, 3, 4, 5 on 5, 2, 0, 2, 0, 1 days.

RESULTS: The downy mildew was observed in the field on all the five occasions when it was predicted, however, the absence of downy mildew was correctly predicted only 60% of the time. Thus, BREMCAST was quite accurate in predicting downy mildew occurrence.

CONCLUSIONS:

General purpose and commercial applications:

The purpose of the software is to predict the potential lettuce downy mildew disease risk. The output data (DSVs and CDSVs) from this forecasting system could be used by scouts and lettuce producers to manage downy mildew of lettuce. Higher disease severity values are associated with higher potential for sporulation, spore dissemination and infection and could be used as a decision tool to time fungicide (chemical or other control methods) applications. Protective measures could be undertaken when "moderate or severe disease" is forecasted. Software is available for testing under your local conditions, upon request by contacting the author.

Literature cited:

1. Tchervenivanova, E. 1995. Development of a model to predict sporulation of *Bremia lactucae* in lettuce. M. Sc. Thesis, McGill University. 77pp.
2. Bhaskara Reddy, M. V., Kushalappa, A. C. and Stephenson, M. M. P. 1996. Effect of solar radiation on the survival of *Bremia lactucae* spored on lettuce. Congress, Societe de Protection des Plantes du Quebec, June 6-7, Quebec City.
3. Kushalappa, A. C. and Scherm, H. 1996. Prediction of downy mildew occurrence in commercial fields. Societe de Protection des Plantes du Quebec, June 6-7; Quebec City.
4. Scherm, H., and van Bruggen, A. H. C. 1994. Weather variables associated with infection of lettuce by downy mildew (*Bremia lactucae*) in coastal California. Phytopathology 84:860-865.
5. Scherm, H., and van Bruggen, A. H. C. 1995. Concurrent spore release and infection of lettuce by *Bremia lactucae* during mornings with prolonged leaf wetness. Phytopathology 85:552-555.

1999 PMR REPORT # 82 SECTION K: VEGETABLES and SPECIAL CROPS - DISEASES
ICAR: 206003

CROP: Chinese Kale (*Brassica alboglabra*)
White green heart (*Brassica campestris chinensis* group var. *utilis*)
Shanghai pak choy (*Brassica campestris chinensis* group var. *utilis*)
Flowering edible rape (*Brassica chinensis* var. *oleifera*)
PEST: Clubroot, *Plasmodiophora brassicae*

NAME AND AGENCY:
McDONALD M R and ROBERTS L A
Muck Crops Research Station
1125 Woodchoppers Lane
RR #1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546

TITLE: MANAGEMENT OF CLUBROOT OF ASIAN CRUCIFER CROPS, 1999

MATERIALS: PERKLA (50% calcium oxide, 14% cyanamide, 2% nitrate), AGRAL 90 (150 mg/m^3 isobutanol, 15 mg/m^3 nonyl phenol ethoxylates), LIME (dolomitic, 22% calcium, 12% magnesium).

METHODS: Two Muck Crop Research Station (MCRS) sites (sites 1 and 2, organic muck soil, pH 6.6) were established in the Holland Marsh, Ontario. Clubroot is endemic at these sites. Site 1 consisted of 5 treatments and site 2 consisted of six treatments. A randomized complete block arrangement was used. Each replicate consisted of eight beds 5 m in length. Each site was direct seeded with 4 varieties of Asian crucifers. At each site, account was taken of the quantity of nitrogen provided by calcium cyanamide (PERLKA) and appropriate rates of standard nitrogen fertilizer were applied to raise the total amount of nitrogen in all treatments to similar levels. All treatments (except drench) were broadcast by hand on to measured areas to ensure uniformity of application and were pre-plant incorporated to a depth of 5-10 cm. Three rates of PERLKA were applied at 1000 kg/ha, 500 kg/ha and 333 kg/ha (in 20 cm bands). At site 2, a drench treatment was applied by hand around the base of the plants approximately three weeks after thinning of 0.25 ml AGRAL 90/50ml water. Dolomitic lime was also pre-plant incorporated at 4.9 tons/ha. An untreated check was also included. Soil samples were taken for analysis when the fertilizers were applied. Relative soil moisture was measured and recorded for each site using the microwave drying method. The air temperatures were above the long term (10 year) average for June, July and September and below average for August. Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71 mm) and August (78.8mm) and above average for September (137.5 mm). Weed germination counts of 1 m^2 were taken on 24 Jun and 6 Jul for site 1, and on 17 Sep for site2. At both sites, a harvest sample of approximately 30 plants from each repetition and each variety were taken and the roots were graded for clubroot incidence and disease severity. Disease severity was assessed using a scale from zero to three: zero - no clubbing, one - < 25 % of root system clubbed, two - 25 to 50 % of root system clubbed and three - > 50 % root system clubbed (Humpherson-Jones, 1989). The disease severity assessment scale was then multiplied by a factor (zero x 0, one x 1, two x 2 and three x 4) and summed for disease severity. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V. 4.1.

RESULTS: As presented in Tables 1, 2 and 3.

CONCLUSIONS: For flowering edible rape, all treatments significantly reduced clubroot incidence and severity compared to the check (Table 2, 3). All treatments reduced clubroot severity in white green heart compared to the check (Table 3). The treatments had no significant effects on weed germination (Table 1). There were no significant differences among the PERLKA treatments. The long term total rainfall average indicates that this was an extremely dry summer. Sites 1 and 2 had a soil moisture content of 247.4% (w/w) when fertilized. According to the manufacturer, PERLKA requires high soil moisture content to decompose effectively. Thus, since it was such a dry season, it is possible that the PERLKA did not function to it's true potential. No phytotoxicity was noted during the trial, on any of the treatments.

* Partial funding for this project was made available by Perform Trading Inc. and The Agriculture Adaptation Council with the support of the Ontario Fruit and Vegetable Growers Association.

Table 1. Control of weeds in Asian crucifers at 2 MCRS sites (S1 and S2), 1999.

		Weed Population (m^2) *		
		S1	S1	S2
Treatment	Rate	24 Jun	6 Jul	17 Sep
Check		80.3 ns**	91.0 ns	37.8 ns
LIME	4.9 ton/ha	92.8	83.8	55.8
AGRAL 90	0.25 ml/50 ml H_2O	------	------	58.3
PERLKA	1000 kg/ha	36	60	51.8
PERLKA	500 kg/ha	69	91.8	59.8
PERLKA	333 kg/ha	38	53.5	65.3

* Weeds present in total number are those of chickweed, common groundsel, oakleaf goosefoot, mapleleaf goosefoot, portulaca, redroot pigweed, prostrate pigweed and biennial wormwood.

** ns - no significant differences (P=0.05, Fisher's Protected LSD Test) were found among the treatment.

Table 2. Clubroot incidence (%) from 30 plants at harvest at 2 MCRS field sites (S1 and S2), in 1999.

		Clubroot Harvest Incidence (%)							
		Chinese kale		White green heart		Shanghai pak choy		Flowering edible rape	
Treatment	Rate	S1	S2	S1	S2	S1	S2	S1	S2
Check		56.3 ns*	10.9 ns	66.5 ns	2.6 ns	79.0 ns	8.4 ns	45.4 a**	1.9 ns
LIME	4.9 ton/ha	47.8	5.1	38.0	3.3	49.2	8.3	8.0 b	1.9
AGRAL 90	0.25ml/ 50 ml H_2O	----	8.1	----	5.1	----	1.7	----	0.8
PERLKA	1000 kg/ha	33.1	7.5	23.6	6.6	32.3	3.3	11.4 b	2.4
PERLKA	500 kg/ha	19.9	8.1	18.3	1.7	25.6	0.0	11.3 b	0.8
	333 kg/ha	20.2	0.0	20.7	1.7	39.7	0.9	9.7 b	0.0

* ns - no significant treatment effects were observed

** Numbers in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

Table 3. Clubroot severity from 30 plants at harvest at 2 MCRS field sites (S1 and S2), in 1999.

		Clubroot Harvest Severity							
		Chinese kale		White green heart		Shanghai pak choy		Flowering edible rape	
Treatment	Rate	S1	S2	S1	S2	S1	S2	S1	S2
Check		32.5 ns*	3.5 ns	37.8 a**	0.8 ns	47.8 ns	2.8 ns	26.2 a	0.5 ns
LIME	4.9 ton/ha	21.3	1.8	10.0 b	1.0	20.5	2.8	1.8 b	0.5
AGRAL 90	0.25ml/ 50 ml H_2O	----	2.8	----	2.0	----	0.5	----	0.3
PERLKA	1000 kg/ha	16.5	2.5	9.8 b	2.5	17.6	0.0	2.2 b	0.8
PERLKA	500 kg/ha	6.0	2.5	6.8 b	0.5	10.0	0.0	2.8 b	0.3
PERLKA	333 kg/ha	8.3	0.0	5.0 b	0.5	15.0	0.3	4.5 b	0.0

* ns - no significant treatment effects were observed

** Numbers in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

1999 PMR REPORT # 83 SECTION K: VEGETABLES AND SPECIALTY CROPS - Diseases
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Cortland
PEST: Onion Smut (*Urocystis cepulae* Frost)

NAME AND AGENCY:
HOEPTING C A[1], MCDONALD M R[2] and SCOTT-DUPREE C D[1]
[1]Dept. of Environmental Biology, University of Guelph
Guelph, Ontario N1G 2W1
Email: choeptin@uoguelph.ca; csdupree@evbhort.uoguelph.ca

[2]Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
R.R.#1 Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF FUNGICIDE AND INSECTICIDE TREATMENT COMBINATIONS FOR THE CONTROL OF ONION SMUT: FIELD TRIAL IN THE HOLLAND MARSH, 1999.

MATERIALS: PRO GRO D (carbathiin 30% + thiram 50%), DITHANE DG (mancozeb 75%), LORSBAN G (chlorpyrifos 15%), GOVERNOR WP (cyromazine 75%), AZTEC G (phosetbupirin 2.0% + cyfluthrin 0.1%), REGENT WG (fipronil 80%).

METHODS: The trial was conducted in naturally infested muck soil (pH 6.4, OM 60%) at the Muck Crops Research Station in the Holland Marsh and was arranged in a randomized complete block design with a total of 20 treatments and four replications. PRO GRO 30/50D, GOVERNOR 75WP and REGENT 80WG seed treatments were commercially film-coated at rates of 20, 50 and 25 g ai/kg of seed respectively by Bejozaden Ltd in Holland. Granular formulations of DITHANE DG (6.6 kg ai/ha), LORSBAN 15G (4.8 kg ai/ha) and AZTEC 2/0.1G (0.5 kg ai/ha) were applied in-furrow at the time of planting. The trial was seeded at a rate of 47 seeds/m of row on 4-6 May, using a push V-belt seeder. Each treatment plot consisted of four 6 m rows of onions spaced 40 cm apart. Six separate 2 m sections were randomly selected for each of five onion smut assessments and final yield. To determine initial stand, emergence counts were taken on 21, 25, 28 May and 2 June in each 2 m section. At the first- (7 Jun), fourth- (25 Jun), 6-7 (12 Jul) and 9-10 (17 Aug) true leaf stages, and at final harvest (15-17 Sep) all the onions in the 2 m sections of row were pulled and visually examined for smut infection. Twice weekly from 7 Jun to 12 Aug, dying onions were pulled and their cause of death (smut, onion maggot or other) was recorded. At final harvest, weight and bulb size were taken from the remaining 2 m section of onions. Data was analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V.4.1. Interaction between fungicides (none, PRO GRO, DITHANE DG, PRO GRO+DITHANE DG) and insecticides (none, LORSBAN, GOVERNOR, AZTEC, REGENT) was analyzed using a 4 x 5 factorial design.

RESULTS: Significant differences were found among treatments for incidence of onion smut at all assessments (Table 1), but not for final yield (data not shown). A significant interaction between fungicides and insecticides was found at the third and forth smut assessments. Significant main effects at all assessments showed that treatment combinations with PRO GRO + DITHANE DG had the least incidence of smut, followed by those with PRO GRO and then those with DITHANE DG. Of the treatments with only insecticides, LORSBAN significantly reduced incidence of smut in comparison to the untreated check in all assessments. Onions treated with GOVERNOR had the highest incidence of smut in four of the five assessments which was always significantly higher than those treated with LORSBAN. Of the PRO GRO + insecticide treatments, the ones with LORSBAN and AZTEC significantly reduced incidence of smut in comparison to PRO GRO alone in three and two of the five assessments, respectively. No common consistent significant differences or trends were found in the treatment combinations with insecticide and DITHANE DG alone. No significant differences were found among the insecticides when they were used in combination with PRO GRO + DITHANE DG at any assessment. The air temperatures were above the long term (10 year) average (LTA) for June (25.3• C), July (28.4• C) and September (22.8• C) and below average for August (24.1• C). Total rainfall was below the LTA for June (68.5 mm), July (71 mm) and August (78.8 mm) and above the LTA for September (137.5 mm).

CONCLUSIONS: Efficacy of fungicide treatments for control of onion smut vary depending on the selection of in-furrow insecticide. Similarly, the effect that an insecticide has on smut varies according to the fungicide treatment that it is used with. The best control of onion smut was achieved when LORSBAN was used in the treatment combination. The nature of such interactions, whether they be chemical, physical or biological require further research, but it is important to consider them in order to optimize the control of onion smut.

Table 1. Percent incidence of onion smut of onions treated with fungicides (PRO GRO, DITHANE DG and DITHANE DG + PRO GRO) in combination with insecticides (LORSBAN, GOVERNOR, AZTEC and REGENT) at the Muck Crops Research Station, Kettleby, Ontario, in 1999.

		Incidence of Onion Smut (%)				
Treatment	Rate	1st true leaf 7 Jun[1]	4 true leaf 25 Jun	6-7 true leaf 12 Jul	9-10 true leaf 17 Aug[1]	harvest 15-17 Sep[1]
untreated		54.7 a[3]	24.6 b	26.4 a	20.0 a	20.5 ab
L[2]	4.8 kg ai/ha	26.0 bc	12.5 cd	11.4 bc	9.56 c	12.4 cd
G	50 g ai/kg[4]	51.8 a	32.5 ab	27.2 a	14.2 ab	22.5 a
A	0.5 kg ai/ha	40.0 ab	28.4 b	15.6 b	13.1 bc	15.4 bc
R	25 g ai/kg	34.5 b	39.7 a	22.7 a	12.7 bc	19.7 ab
PG	20 g ai/kg	19.4 cd	13.2 c	4.17 d-f	3.18 d	4.03 ef
PG+L	20 g ai/kg + 4.8 kg ai/ha	8.37 ef	3.40 ef	1.74 ef	0.96 e-i	1.59 f-h
PG+G	20 g ai/kg + 50 g ai/kg	12.1 de	3.51 ef	4.06 d-f	4.25 de	3.06 e-g
PG+A	20 g ai/kg + 0.5 kg ai/ha	11.0 d-f	2.52 ef	2.42 ef	0.66 f-i	1.43 f-h
PG+R	20 g ai/kg + 25 g ai/kg	20.8 cd	11.2 c-e	8.51 cd	2.62 de	3.32 e-g
DG	6.6 kg ai/ha	28.2 bc	14.6 c	11.8 bc	1.60 d-h	7.11 e
DG+L	6.6 kg ai/ha + 4.8 kg ai/ha	20.1 cd	15.3 c	4.85 d-f	1.60 d-g	4.67 ef
DG+G	6.6 kg ai/ha +50 g ai/kg	35.2 b	13.3 c	7.21 c-e	2.14 d-f	6.95 de
DG+A	6.6 kg ai/ha + 0.5 kg ai/ha	28.9 bc	7.83 c-f	9.22 cd	2.49 de	4.56 ef
DG+R	6.6 kg ai/ha +25 g ai/ha	31.1 bc	14.4 c	9.35 cd	2.68 de	5.13 e
PG+DG	20 g ai/kg + 6.6 kg ai/ha	6.56 e-g	3.40 ef	0.92 f	0.48 hi	1.11 g-i
PG+DG+L	20 g ai/kg + 6.6 kg ai/ha + 4.8 kg ai/ha	1.66 g	1.49 f	1.01 f	0.33 g-i	0.58 hi
PG+DG+G	20 g ai/kg + 6.6 kg ai/ha + 50 g ai/kg	4.84 fg	0.89 f	0.82 f	0.59 g-i	0.13 i
PG+DG+A	20 g ai/kg + 6.6 kg ai/ha + 0.5 kg ai/ha	5.36 e-g	4.09 d-f	0.58 f	0.26 g-i	0.00 i
PG+DG+R	20 g ai/kg + 6.6 kg ai/ha + 25 g ai/kg	4.46 e-g	2.54 ef	0.69 f	0.00 i	0.49 hi

[1] Statistics performed on arcsin• x transformed data

[2] **L**: LORSBAN, **G**: GOVERNOR, **A**: AZTEC, **R**: REGENT, **PG**: PRO GRO, **DG**:DITHANE DG

[3] Numbers in a column followed by the same letter are not significantly different at p=0.05, Fisher's Protected LSD test.

[4] Seed treatment : g ai/kg of seed.

1999 PMR REPORT # 84 **SECTION K: VEGETABLES AND SPECIALTY CROPS - Diseases**
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Quantum, Gazette
PEST: Onion Smut (*Urocystis cepulae* Frost)

NAME AND AGENCY:
HOEPTING C A[1] and MCDONALD M R[2]
[1]Dept. of Environmental Biology, University of Guelph
Guelph, Ontario N1G 2W1
Email: choeptin@uoguelph.ca

[2]Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
R.R.#1 Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF SYNTHETIC GERMINATION STIMULANTS FOR CONTROL OF ONION SMUT, GREENHOUSE TRIALS, IN 1999

MATERIALS: DADS (diallyl disulphide 78%, related compounds 12%), DPDS (n-propyl disulphide 88%, related compounds 2%).

METHODS: Three trials were conducted under controlled conditions in the greenhouse to determine if the application of synthetic germination stimulants to soil would reduce incidence of onion smut. Naturally infested muck soil (pH 6.4, OM 60%, 35% moisture) was collected from the field at the Muck Crops Research Station, sieved through 2mm and thoroughly mixed by hand with 15 mL of synthetic germination stimulant (United Agri-Products) in solution per 10 L of soil. Two percent DADS 78% was applied at a rate equivalent to 60 L/ha in 500 L/ha of water in the top 20cm of field soil and DPDS 88% (2 and 4%) at rates of 60 and 120 L/ha in 500 L/ha of water. Tap water was used as an untreated check. Treated soil was stored at room temperature in closed black polyethylene bags for 12 weeks (14 weeks for trial #1). At this time the trial was planted for a single application trial or the soil was treated again and stored for another 12 weeks before planting a double application trial. All trials were seeded in 200 plug trays and arranged in a randomized complete block design with two cultivars (cvs. Quantum, Gazette) and four replications. To delay emergence and to increase the infection window, Trials #1 and 2 were placed underneath the benches in the greenhouse for the first two weeks (15 ± 3• C) and then they were moved onto the benches (trial #1: 15-25• C, Trial #2: 15 ± 3• C with daily peaks as high as 30• C). The double application trial was started in a dark storage room (15-20• C) before it was moved onto the greenhouse benches (15-40• C) and then outdoors on 11 Jun for the last four weeks of the trial (10-32• C). Twenty-five randomly selected plants were pulled and visually examined for incidence of onion smut at approximately four (flag leaf stage) and ten weeks (3 leaf stage) after planting. Data was analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V.4.1.

RESULTS: Significant differences among treatments were found at all assessments in all trials, except for the first assessment of trial #1 (Table 1 and 2). In most cases, incidence of smut was less in the onions grown in treated soil compared to those grown in untreated soil. In the single application trials, DADS significantly reduced incidence of onion smut by 25 and 35.7% at the second assessment of trial #1and at the first assessment of trial #2 respectively. In the double application trial, DADS did not significantly reduce incidence of onion smut. However, both rates of DPDS significantly reduced incidence of smut by 19.2 - 26.6% and by 22.2 - 31.4% at the first and second assessments respectively. Only at the second assessment of trial #2 was there a significant difference between the two rates of DPDS. Here, under very high levels of smut (untreated: 94.1%), the high rate was the only treatment that significantly reduced incidence.

CONCLUSIONS: The efficacy of DADS and DPDS was not consistent across trials, but when control was achieved by any germination stimulant it was approximately from 10 to 35%. The inoculum concentration of smut in the soil is unknown, but it is likely very high due to the high incidence of infection found in these trials. Perhaps with a lower inoculum density, better control would be achieved. DPDS is less effective for control of white rot and therefore the potential for developing this material is limited. The application of DADS for smut control alone would not be economical, but a gradual reduction of smut may be a fringe benefit of DADS use for white rot control.

Table 1. Percent incidence of onion smut (OS) of onions grown in naturally infested soil treated with a single application of synthetic germination stimulants (trial #1: treated 5-Jun-98, planted 6-Oct-98; trial #2: treated 3 Nov 98, planted 26 Jan 99).

		Trial #1: Fall 1998		Trial #2: Winter 1999	
Treatment	Rate (L/ha in 500L/ha water)	% OS 4.5 weeks[1]	% OS 8.5 weeks	% OS 4 weeks	% OS[4] 10 weeks
untreated		74.3 NS[2]	66.2 a[3]	77.1 a	94.1 a
DADS	60	59.1	49.9 b	49.6 c	88.8 a
DPDS	60	73.8	59.0 ab	59.8 bc	93.3 a
DPDS	120	73.1	68.3 a	65.3 ab	75.4 b

[1] Number of weeks after trial planted

[2] NS: no significant differences were found at p=0.05, Fisher's Protected LSD test

[3] Columns followed by the same letter are not significantly different at p=0.05, Fisher's Protected LSD test

[4] Significant differences were found between cultivars, Quantum had higher levels of smut

Table 2. Percent incidence of onion smut of onions grown in naturally infested soil treated with a double application of synthetic germination stimulants (treated: 3 Nov 98, 26 Jan 99; planted: 21 Apr 99) - Spring 1999.

Treatment	Rate (L/ha in 500L/ha water)	Incidence of Onion Smut (%)	
		3 weeks[1,2]	11 weeks
untreated		76.5 a[3]	69.1 a
DADS	60	69.3 ab	59.1 ab
DPDS	60	61.8 b	47.4 b
DPDS	120	56.1 b	53.8 b

[1] Number of weeks after planting.

[2] Significant difference (p=0.05) among cultivars, Gazette had higher levels of smut

[3] Columns followed by the same letter are not significantly different at p=0.05, Fisher's Protected LSD test.

1999 PMR REPORT # 85 SECTION K: VEGETABLES AND SPECIALTY CROPS - Diseases
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Quantum, Gazette
PEST: Onion Smut (*Urocystis cepulae* Frost)

NAME AND AGENCY:
HOEPTING C A[1] and MCDONALD M R[2]
[1]Dept. of Environmental Biology, University of Guelph
Guelph, Ontario N1G 2W1
Email: choeptin@uoguelph.ca

[2]Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
R.R.#1 Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-454; Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF *ALLIUM* PRODUCTS AS GERMINATION STIMULANTS FOR CONTROL OF ONION SMUT, GREENHOUSE TRIALS, IN 1999

MATERIALS: DADS (diallyl disulphide 78%, related compounds 12%), DPDS (n-propyl disulphide 88%, related compounds 2%), GARLIC OIL (composition unknown), GARLIC JUICE (diallyl disulphide 0.026%) GARLIC POWDER (diallyl disulphide 0.092%), HOMEMADE ONION JUICE (composition unknown).

METHODS: Two trials were conducted under controlled conditions in the greenhouse to determine if the application of various *Allium* products to soil would stimulate teliospore germination and reduce incidence of onion smut. Naturally infested muck soil (pH 6.4, OM 60%, 35% moisture) was collected from the field at the Muck Crops Research Station, sieved through 2mm and thoroughly mixed by hand with 2.5 mL of *Allium* product in solution per 10 L of soil. The rates applied were equivalent to L/ha product in 500 L/ha water in the top 20 cm of soil in a field and included 1 and 2% GARLIC OIL (Gibbson Foods,) at 5 and 10 L/ha, 2% GARLIC JUICE (Perth Garlic Growers) and freshly squeezed 2% HOMEMADE ONION JUICE both at 10 L/ha, and 0.2g/mL GARLIC POWDER (Empire Foods) at 280 kg/ha in 1500 L/ha water. Synthetic germination stimulants, DADS 78% (1 and 2%) and DPDS 88% (2 and 4%) were applied at 5 and 10, and 10 and 20 L/ha respectively. Tap water was used as an untreated check. Treated soil was stored at room temperature in closed black polyethylene bags for 13 weeks at which time the single application trial was planted. For the double application trial, the soil was treated again and stored for another 12 weeks before planting. Trials were seeded in 200 plug trays and arranged in a randomized complete block design with two cultivars (cvs. Quantum, Gazette) and four replications. To delay emergence and to increase the infection window, the single application trial was placed underneath the benches in the greenhouse for the first two weeks until emergence (15 ± 3• C with peaks of 25• C) and then they were moved to the benches (15 - 30• C). Similarly, the double application trial was started in a dark storage room (15-20• C) before it was moved onto the greenhouse benches (15-40• C) and then outdoors on 11 Jun for the remainder of the trial (10-32• C). Twenty-five randomly selected plants were pulled and visually examined for incidence of onion smut at approximately four (flag leaf stage) and ten weeks (3 leaf stage) after planting. Data was analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V.4.1.

RESULTS: Significant differences among treatments were only found at the first assessment of the double application trial (Table 1). Here, the low rate of DPDS significantly reduced incidence of onion smut better than all other treatments (25% control compared to the untreated) except for the low rate of DADS. Although not significant, incidence of smut was higher in the treatments than in the untreated check at the second assessment of both trials, with the exception of the HOMEMADE ONION JUICE treatment. When incidence of smut was reduced compared to the check, the higher rate of GARLIC OIL and the lower rate of DPDS were more effective. Differences between the two rates of DADS was insignificant and inconsistent. Applying a second treatment to the soil did not appear to enhance the efficacy of any of the treatments.

CONCLUSIONS: The variability of these results may be indicative of the natural variability of soil inoculum concentrations. At the rates tested, none of the *Allium* products or synthetic germination stimulants were sufficiently effective at reducing onion smut, although the low rate of DPDS and HOMEMADE ONION JUICE show potential.

Table 1. Percent incidence of onion smut (OS) of onions grown in naturally infested soil treated with *Allium* products and synthetic germination stimulants (Single Application: treated 20 Oct 98, planted 19 Jan 99; Double Application: treated 20 Oct 98 & 21 Jan 99, planted 16 Apr 99).

Treatment	Rate (L/ha in 500 L/ha water)	Single Application % OS 4 weeks[1]	Single Application % OS 10 weeks	Double Application % OS[2] 3.5 weeks	Double Application % OS 10 weeks
untreated		43.6 NS[3]	73.0 NS	81.9 a-c[4]	52.3 NS
DADS	5	42.4	75	72.3 cd	60.6
DADS	10	38.3	82.2	80.3 a-c	61.3
DPDS	10	37.7	79.8	61.4 d	54.3
DPDS	20	44.7	87.4	73.6 bc	52.2
GARLIC OIL	5	43.7	85.8	87.2 a	74.3
GARLIC OIL	10	37.4	82.1	74.2 bc	60.1
GARLIC POWDER	280 kg/ha in 1500 L/ha water	47.1	89.5	86.0 ab	60.3
GARLIC JUICE	10	37	75.1	75.2 a-c	57.4
ONION JUICE	10	30.4	69.3	74.7 bc	50.3

[1] Number of weeks after trial planted

[2] Significant difference among cultivars at p=0.05, Fisher's Protected LSD test, Gazette had higher incidence of smut.

[3] No significant differences were found among treatments at p=0.05, Fisher's Protected LSD test.

[4] Columns followed by the same letter are not significantly different at p=0.05, Fisher's Protected LSD test.

1999 PMR REPORT # 86 **SECTION K: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.), cv. Fortress, Hoopla and Asgrow XPH15055
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
JAIME M D L A, HOVIUS M H Y AND M R MCDONALD
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775-4546 Email: mjaime@uoguelph.ca

TITLE: FIELD EVALUATION OF TEBUCONAZOLE SEED AND BAND APPLICATIONS FOR THE CONTROL OF ONION WHITE ROT (*SCLEROTIUM CEPIVORUM* BERK), 1999.

MATERIALS: Onions (cv. Frontier), RAXIL (tebuconazole 8%), FOLICUR (tebuconazole 38.7%).

METHODS: Onions were seeded in a commercial field (organic muck soil) with a history of white rot in the Holland Marsh, Ontario on 20 May, 1999. The treatments consisted of 1)Fortress check (mid-maturing cultivar), 2)Hoopla check (susceptible mid-maturing cultivar), 3)Asgrow XPH15055 check (resistant control), 4) Fortress + tebuconazole seed treatment (RAXIL at 0.5 g a.i. /kg of seed) , 5)Fortress + FOLICUR at 1L/ ha in 500L of water. 6)Fortress + RAXIL + FOLICUR. FOLICUR was sprayed on 26 July, 1999 using a Solo back pack sprayer (60 psi.) with a fan-jet nozzle. All seed for the RAXIL treatments was treated on 20 May, 1999. RAXIL was applied to the seed using methyl cellulose to ensure proper distribution of the chemical. Three untreated checks were also included Fortress (mid-maturing cultivar), Hoopla (susceptible mid-maturing cultivar), Asgrow XPH15055 (resistant cultivar), . The onions were seeded using a V-belt push seeder delivering 39 to 46 seeds/ m. A randomized complete block design with 4 replications per treatment was used. Each replicate consisted of 2 rows, 3 m in length. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Air temperatures were above the long term (10 year) average for June (25.3°C), July (28.4°C) and September (22.8°C), Below average for August (24.1°C). Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71 mm) and August (78.8 mm) and above average for September (137.5 mm). No irrigation was used to offset the lack of precipitation during seedling emergence and plant growth. Onion bulbs were assessed for white rot incidence at harvest maturity, on Oct 2, 1999. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: The results are summarized in Table 1.

CONCLUSIONS: No significant differences were found among fungicide treatments tested. Cultivar Hoopla was more susceptible than the other cultivars. Incidence of white rot was low (3.88 to 16.84%) due to the hot dry weather in 1999 which was unfavorable for white rot development. Under low disease pressure, tebuconazole did not appear to give control of white rot bulb infection.

Table 1. Harvest incidence of white rot in one onion cultivar (Fortress) grown at one commercial site in the Holland Marsh, Ontario, treated with seed and spray in bands of tebuconazole, in 1999.

Cultivar	Tebuconazole formulation	Rates	White Rot Incidence (%)
Fortress	untreated	NA*	4.73 b**
Hoopla	untreated	NA	16.84 a
Asgrow XPH15055	untreated	NA	3.88 b
Fortress	RAXIL	0.5 g / kg of seed	5.61 b
Fortress	FOLICUR	1L / ha in 500L water	4.62 b
Fortress	FOLICUR + RAXIL	1L / ha in 500L water + 0.5 g / kg of seed	5.86 b

* NA = not applicable

** Numbers in a column followed by the same letter are not significantly different at P=0.05, Fisher's Protected LSD test.

1999 PMR REPORT # 87 **SECTION K: VEGETABLES and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow Cooking Onion (*Allium cepa* L.), cv. Cisco
PEST: White rot, *Sclerotium cepivorum* (Berk)

NAME AND AGENCY:
JAIME M D L A, HOVIUS M H Y AND MCDONALD M R
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph,
RR#1, Kettleby, Ontario L0G 1J0
Tel.: (905) 775-3783 Fax: (905) 775-4546 Email: mjaime@uoguelph.ca

TITLE: FIELD EVALUATION OF TEBUCONAZOLE BAND APPLICATION FOR THE CONTROL OF ONION WHITE ROT (*SCLEROTIUM CEPIVORUM* BERK), 1999.

MATERIALS: FOLICUR (tebuconazole 38.7%).

METHODS: Onions (cv. Cisco) were transplanted in organic soil naturally infested with the pathogen in a commercial field in the Keswick Marsh, Ontario on 26 April, 1999. The onions were transplanted and managed for the full season by the grower. Tebuconazole (FOLICUR at 1 L/ha in 500 L of water) was applied in a band once on 24 June, 1999 using a Solo back pack sprayer (60 psi.) with a fan-jet nozzle. The treatment was applied after onions with visible white rot symptoms were rogued on 14 June, 1999. Plant spacing was 23 plants/m. in 8 rows, 3 m in length with the same area between replications. A randomized complete block design with 4 replications per treatment was used. Recommended control procedures for fungal and bacterial pathogens, weeds and insects were followed. Air temperatures were above the long term (10 year) average for June(25.3°C), July (28.4°C) and below average for August (24.1°C). Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71 mm) and August. (78.8 mm). Onions were irrigated three times after transplanting on April 27, May 4, May 11, 1999. Onion bulbs were assessed for white rot incidence at maturity, on 3 August, 1999. Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix, V. 4.1.

RESULTS: The results are summarized in Table 1.

CONCLUSIONS: FOLICUR applied as a banded spray significantly reduced the indecence of onion white rot compared to the untreated check. FOLICUR has potential as a method of control when applied as banded spray. The main effect of this treatment was to reduce the number of onions affected by disease at the harvest time. FOLICUR is not currently registered for control of white rot in onions.

FOLICUR effectively reducede disease when applied mid-season after disease symptoms were observed. A minor use application for Tebuconazole on onions will be pursued.

Table 1. Harvest incidence of white rot on onion cv. Cisco grown at a commercial site in the Keswick Marsh, Ontario, and treated with tebuconazole sprayed in bands in 1999.

Treatment	Rate	White Rot Harvest Incidence (%)
Check	Untreated	26.94 a*
FOLICUR	1 L\ha in 500 L of water	15.35 b

* Numbers in a column followed by a different letter are significantly different at P=0.05, Fisher's Protected LSD test.

1999 PMR REPORT # 88 **SECTION K: VEGETABLE and SPECIAL CROPS - Diseases**
ICAR: 206003

CROP: Yellow cooking onions (*Allium cepa* L.), cv. Festival
PEST: Onion Smut, *Urocystis cepulae* (Frost)

NAME AND AGENCY:
MCDONALD M R, VANDER KOOI K AND JANSE S
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
1125 Woodchoppers Lane, RR#1, Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF FILM COATING AND FURROW FUNGICIDE TREATMENTS FOR CONTROL OF ONION SMUT, 1999

MATERIALS: DITHANE DG (mancozeb 75%), GOVERNOR (cyromazine 75%), MANEB (maneb 80%), PRO GRO (carbathiin 30%, thiram 50%), methyl cellulose

METHODS: Onions cv. Festival were seeded (46 seeds/m) in organic soil (pH 6.4, organic matter 60%) naturally infested with onion smut at the Muck Crops Research Station on 30 April, 1999. Treatments were: film coat at 0.75% and 3.0%, film coat + PRO GRO at 20 g ai/kg, film coat + GOVERNOR at 50 g ai/kg, film coat + PRO GRO at 20 g ai/kg + GOVERNOR at 50 g ai/kg, film coat + MANEB at 20 g ai/kg, film coat plus MANEB at 20 g ai/kg plus PRO GRO at 20 g ai/kg, PRO GRO treated pelleted seed, PRO GRO at 25 kg/ha + a 1% methyl cellulose solution per kg of seed, DITHANE DG at 8.8 kg/ha and a PRO GRO treated pelleted seed + DITHANE DG at 8.8 kg/ha. An untreated check was also included. A randomized complete block arrangement with 4 blocks per treatment was used. Each replicate consisted of 2 rows (42 cm apart), 5 m in length. All treatments were seeded using a push V-belt seeder. All DITHANE DG treatments were applied on the V-belt along with the seed. Three random 2 m sections were marked off, and germination counts were recorded (19, 21, 25 May and 2 June) to determine initial stands. At one (3 June) and three (6 July) true leaves, one of the 2 m sections were harvested and evaluated by looking at the bulb and leaves for evidence of smut. The remaining 2 m section was evaluated on 16 September, and a yield section of 2.33 m was taken on 28 September. The air temperatures were above the long term (10 year) average for June, July and September and below average for August. Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71 mm) and August (78.8 mm) and above average for September (137.5 mm). Data were analyzed using the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As outlined in Table 1.

CONCLUSIONS: Significant differences in onion smut incidence was found on all assessment dates. PRO GRO film coat, DITHANE DG and PRO GRO pellet + DITHANE DG treatments reduced onion smut compared to the untreated check on all assessment dates. PRO GRO in the pellet and PRO GRO + methyl cellulose on raw seed reduced onion smut on the first and third assessments. PRO GRO + GOVERNOR in the film coat and MANEB + PRO GRO in the film coat also resulted in a lower incidence of onion smut on the first and third assessment dates, however, MANEB alone was not effective and GOVERNOR alone only reduced smut on the third assessment date. Thus, the effectiveness of these treatments can be attributed to the PRO GRO. The two rates of film coating did not affect onion smut, compared to the untreated control. No treatments had a significant effect on the yield.

Table 1. Evaluation of film coating and furrow fungicides for the control of onion smut 1999.

Treatments	Rate of Product	Incidence of Smut %			Yield T/Ha[3]
		3 June	6 July	16 Sept	
Control		31.0 de[1]	11.7 cde	7.8 c	8.1 NS[2]
Film Coat (FC)	0.75%	40.0 e	12.5 cde	8.6 c	8.6
Film Coat (FC)	3.0%	59.5 e	15.2 e	8.5 c	8.2
PRO GRO (FC)	20 g ai/kg	11.5 abc	5.0 ab	1.9 a	9
GOVERNOR (FC)	50 g ai/kg	21.5 cd	13.7 de	4.0 a	9.9
PRO GRO + GOVERNOR (FC)	20 + 50 g ai/kg	15.0 abc	7.7 bc	1.0 a	7.4
MANEB (FC)	20 g ai/kg	20.2 bcd	10.7 cde	6.7 bc	9.4
MANEB + PRO GRO (FC)	20 g + 20 g ai/kg	9.5 ab	3.7 ab	2.1 a	8.1
PRO GRO pellet		16.7 abc	8.7 bcd	2.4 ab	8.9
PRO GRO + mc[4]	25 kg/kg of seed	8.5 a	8.5 bcd	1.2 a	7.8
DITHANE DG	8.8 kg/ha	15.2 abc	5.2 ab	1.4 a	9.1
PRO GRO pellet + DITHANE DG	8.8 kg/ha	9.0 a	0.7 a	0.7 a	10.1

[1] Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

[2] NS = no significant treatment effects were observed.

[3] Bushels per Acre = Tons per Hectare x 17.8

[4] mc = methyl cellulose.

1999 PMR REPORT # 89 SECTION K: DISEASES OF VEGETABLES AND SPECIAL CROPS

CROP: Sugar beet (*Beta vulgaris* L.) cv. E17
PEST: Cercospora blight (*Cercospora beticola*) Sacc.

NAME AND AGENCY:
CERKAUSKAS, R F, AND BROWN, J
Agriculture and Agri-Food Canada
Greenhouse and Processing Crops Research Centre, Harrow, Ontario N0R 1G0.
Tel: (519)738-2251 Fax: (519)738-2929 Email: cerkauskasr@em.agr.ca

TITLE: EFFICACY OF FUNGICIDES FOR CONTROL OF CERCOSPORA LEAF SPOT OF SUGAR BEET AT HARROW, ONTARIO IN 1999.

MATERIALS: BRAVO 500 (50% w/w chlorothalonil), QUADRIS (22.9% w/w azoxystrobin), MANZATE 200DF (80% w/w mancozeb).

METHODS: The trial was established at the research farm at Harrow, Ontario in a Harrow clay loam soil using sugar beet cv. E17. Ro-Neet 72 EC was pre-plant incorporated at 4.73 KgL/ha for weed control, and fertilizer (20-10-10) was broadcast at 300 Kg/ha prior to planting. The trial was located at the same site where a similar experiment had been conducted the previous year and inoculum of *Cercospora beticola* was obtained from affected sugar beet debris. A randomized complete block design with four replicates was used. Each subplot consisted of four 5m rows spaced 0.5m apart and a plant spacing of 0.15m. The sugar beet was planted on 6 May, and sweet corn (cv. Supersweet) was planted as a border around each subplot to prevent interplot interference from fungal inoculum.. BRAVO, QUADRIS, and MANZATE were applied at 1.14L, 0.09L, and 0.72 kg per hectare in 825 L/ha spray volume using a backpack sprayer with adjustable Rapid-5 nozzles at about 200 kPa. Fungicide sprays were applied every 6 to 17 days depending upon occurrence of rain. A total of 10 sprays were applied with the first and last sprays on 4 August and 29 October, respectively. Cercospora blight severity was rated using the Horsfall-Barratt scale (1) generally every 7 to 14 days from 30 July to 29 October. Area under the disease progress curve (AUDPC) was evaluated according to Shaner and Finney (2). Yield per subplot, obtained on 9 November, consisted of 10 roots randomly chosen from the middle two rows. The percent purity of juice, sucrose in the beet, and recoverable white sugar per ton were determined with refractometer and polarimeter readings at Michigan Sugar Company (Croswell, MI). Analysis of variance (General Linear Model Procedure, SAS) was used to analyze foliar disease, yield and sugar recovery data. The FLSD at P=0.05 was used for comparison of means.

RESULTS: Cercospora leaf spot severity of 7.6%, 5.6%, 6.5%, and 26.5% corresponding to the unsprayed check, BRAVO, QUADRIS and MANZATE treatments, respectively, was already high at the first disease rating. Fungicide treatments reduced final disease severity and AUDPC with respect to the control, although differences were significant only in the latter case (Table 1). Lowest disease levels were observed with the QUADRIS treatment while AUDPC and final disease severity were similar with MANZATE and BRAVO treatments. There were no significant differences in yield among the treatments. All fungicides increased the percent recovery of clarified juice and sucrose in comparison to the unsprayed treatment; however, differences were only significant in the latter case, with the QUADRIS treatment at the highest levels. The recoverable white sugar expressed as pounds per ton of beets was also significantly higher in the fungicide treatments than in the unsprayed treatment, however, there were no significant differences among treatments in the quantity of recoverable white sugar per acre although the QUADRIS and BRAVO treatments had the lowest and highest values among all the treatments, respectively.

CONCLUSIONS: High initial disease severity precluded effective control of Cercospora leaf spot with respect to final disease severity, root yield, % clarified juice purity, and pounds of recoverable white sugar per acre of beets harvested. Earlier fungicide application may result in significant benefits to these variables as noted in the 1998 trial. However, fungicide treatments in 1999 did reduce Cercospora leaf spot development, increased the sucrose content of the roots, and increased the recoverable white sugar per ton of harvested roots with respect to the unsprayed control.

REFERENCES:

1. Horsfall, J.G., and Barratt, R.W. 1945. An improved grading system for measuring plant diseases. Phytopathology 35:655. (Abstr.)
2. Shaner, G., and Finney, R.E. 1977. The effect of nitrogen fertilization on the expression of slow-mildewing resistance in Knox wheat. Phytopathology 67:1051-1056.

ACKNOWLEDGEMENTS: We thank Mr. M. Ferrar for technical assistance.

Table 1. Effect of foliar fungicide treatments in sugar beet on Cercospora blight final disease severity, AUDPC, and yield at Harrow, Ontario, 1999*.

Fungicide Treatment	Rate L/ha	Final % Disease Severity	AUDPC	Yield kg/ 10 roots	% Clarified Juice Purity	% Sucrose	Recoverable White Sugar	
							lbs/ton	lbs/acre
Unsprayed	----	62.5	51.2	6.21	91.62	17.07	233.27	7014.3
QUADRIS	0.1	37.5	30.3	5.16	92.92	19.08	270.6	6770.4
BRAVO	1.14	50	43	7.35	92.34	17.94	250.08	8931.6
MANZATE	0.72[a]	50	47.5	6.02	91.28	17.86	242.69	7048
$FLSD_{0.05}$		NS**	14.1	NS	NS	0.85	19.34	NS

* The values in this table are the means of four replications.

** NS = not significant

[a] kg/ha.

END OF SECTION K (Report # s 79-89; pages 208-238).

SECTION L: **FIELD LEGUMES (Beans, peas)/ Légumineuses de grande culture (haricots, pois)**

REPORTS /RAPPORTS # 90 - 112

PAGES: 239 - 304

EDITOR **Dr. Terry Anderson**

Agriculture and Agri-Food Canada
Greenhouse and Processing Crops
Research Centre, Highway 18
Harrow, Ontario N0R 1G0

Email: andersont@em.agr.ca
Tel: (519) 738-2251
Fax: (519) 738-2929

1999 PMR REPORT # 90 **SECTION L:** **DISEASES OF FIELD LEGUMES**
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris* L.), cv. Othello (Pinto type)
PEST: Halo blight [*Pseudomonas syringae* pv. *phaseolicola* (Burkh.) Young *et al.*]

NAME AND AGENCY:
CHANG K F, HOWARD R J, and BRIANT M A
Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South
SS 4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 Fax: (403) 362-1326 Email: changk@agric.gov.ab.ca

VAN ROESSEL W
Specialty Seeds Inc.
P.O. Box 965, Bow Island, Alberta T0K 0G0
Tel: (403) 545-6018 Fax: (403) 545-6018 Email: wvanroes@memlane.com

TITLE: SEED TREATMENT AND FOLIAR APPLICATION OF KOCIDE LF TO CONTROL HALO BLIGHT OF DRY BEAN AT BOW ISLAND, ALBERTA IN 1999

MATERIALS: KOCIDE LF (copper hydroxide 23% SU)

METHODS: Seeds of Othello, a blight-susceptible dry bean cultivar, were inoculated with the halo blight pathogen (*Pseudomonas syringae* pv. *phaseolicola* [*Psp*]). Flasks of nutrient broth containing isolates of *Psp* were shaken for 18 hours at 22°C on a rotary shaker, then centrifuged for 10 minutes at 8,000 rpm. The supernatant was discarded and the pellets were resuspended in water, diluted to 10^8-10^9 cfu/mL and added to 1 kg of seed, which was allowed to air dry for two days. Some of the inoculated seeds were treated with KOCIDE LF (1.5 mL KOCIDE on 575 g seed), a copper-based fungicide and bactericide, using a Gustafson Lab Batch Treater. Treatments are given in Table 1. The treated and untreated seeds were sown in four, 5 m rows per plot on June 2 at Bow Island in a randomized complete block design. Seeds were inoculated a second time by adding 1 mL of a bacterial suspension (6 tablespoons of flour in 225 mL of *Psp*) to each package of seed. Total emergence was counted for each plot on June 28. A KOCIDE solution (1:500 ratio) was sprayed onto leaves at 300 mL/row on June 29 (early spray) and September 2 (late spray). Halo blight incidence and severity were rated on September 2. A visual assessment key was used to estimate severity, ie. 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted). Severity ratings were done on 25 randomly selected leaves and 25 pods per row. Seeds from each plot were harvested on September 22. Data were square root transformed, where necessary, and subjected to ANOVA using the Pesticide Research Manager Program.

RESULTS: There were no significant differences between the treatments for emergence, disease severity and yield (Table 1). However, where inoculated seed was treated with KOCIDE, both emergence and seed yield were higher than for plants treated with foliar sprays alone. A significantly higher disease incidence was noted on plants that were given only an early foliar spray with KOCIDE.

CONCLUSIONS: The use of a copper fungicide (KOCIDE) for seed treatment and applied as early and late foliar sprays provided the best control of halo blight under field conditions. Although there was a higher yield for this treatment, it was not statistically significant when compared to the other treatments.

ACKNOWLEDGEMENTS: The authors wish to thank C.L. Bandura, M.L.Nielsen, S.P. Huggons, T.D. Schick and D.A. Burke for their technical assistance.

Table 1. Emergence, halo blight disease incidence and severity, and yield of Othello dry bean under six treatment regimes in a field trial at Bow Island, Alberta, 1999 [x].

Treatment	Emergence (%)	Disease incidence (%)	Disease severity (0-4)		Yield (g/5m)
			leaves	pods	
Control (Clean seed) - no spray	43.1	4.8b	2.3	1	2516.1
Inoculated seed - no spray	29.2	2.8b	2.3	1.2	2216
Inoculated seed + early spray[z]	21.2	10.3a	2.4	1	2181.6
Inoculated seed + early & late sprays	19.6	5.7b	2.7	0.9	2036.6
Inoculated seed + late spray	22.9	4.2b	2.5	1.4	2291.2
Inoculated, treated seed[y] + early & late sprays	34.7	3.2b	2.5	1	2575.6
ANOVA (P• 0.05)	NS	S	NS	NS	NS
Coefficient of variation (%)	44.3	37.6	10.3	24.8	32.6

[x] Values are means of four replications. Means followed by the same letter in a column do not significantly differ (P• 0.05 Duncan's New Multiple Range Test).

[y] Seed treatment: 1.5 mL KOCIDE LF/575 g seed

[z] Plants sprayed with KOCIDE LF diluted in water at 1:500.

1999 PMR REPORT # 91 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris*), cvs. AC Skipper, CDC Expresso, NW63, Othello, US1140 and Viva
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (strain HB9)
Common blight, *Xanthomonas campestris* pv. *phaseoli* (ATTC 9563)

NAME AND AGENCY:
HOWARD R J, BURKE D A, and HUGGONS S P
Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 Fax: (403) 362-1306 Email: ron.howard@agric.gov.ab.ca

MATERIALS: ZINEB 80WP (zineb 80% WP), BLUESTONE (copper sulfate 64% SG), AGRICULTURAL STREPTOMYCIN (streptomycin sulfate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO®280 (thiram 13.2% + carbathiin 14.9% SU), NITRAGIN® SOIL IMPLANT PLUS (*Rhizobium phaseoli* [1 x 10^8 viable cells per g])

TITLE: EFFICACY OF FOUR CHEMICAL SEED TREATMENTS AGAINST SURFACE-BORNE HALO AND COMMON BLIGHT BACTERIA ON DRY BEANS IN FIELD TRIALS AT BROOKS, ALBERTA IN 1999

METHODS: Six types and cultivars of dry edible beans were artificially infested with halo blight (*Psp*) and common blight (*Xcp)* bacteria and treated with the fungicide VITAFLO-280, alone or in combination with one of the following bactericides: ZINEB 80WP at two rates, BLUESTONE at two rates, and AGRICULTURAL STREPTOMYCIN at one rate. There was also an untreated check. On May 12, the seed was treated in 1.0 kg lots, except for AC Skipper (1.5kg) and NW63 (2.0kg). Each bactericide was combined with 3.5mL of water to form a slurry to which was added 2.6mL of liquid fungicide (the rates were adjusted accordingly for AC Skipper and NW63). The seed was mixed with the chemical formulations for 2 min, then placed in paper bags and allowed to dry overnight in a dark room. The treated seed was stored in a cooler (ca. 4°C) until planting.

The bean seed was artificially infested with *Psp* and *Xcp* prior to chemical treatment. Stock cultures obtained from the Agriculture & Agri-Food Canada Research Centre in Lethbridge, AB, were used to inoculate nutrient broth. The resultant cultures were grown up on a rotary shaker for approximately 48 hr at room temperature. Afterwards, they were centrifuged at 9000 rpm for 30 min and resuspended with a buffered saline solution (0.1M sodium phosphate dibasic anhydrous and 0.85% sodium chloride; pH=7.2). The concentrated solutions were measured with a hemacytometer and determined to have a density greater than 1 x 10^8 colony forming units per mL. The seed was treated with 5mL of culture solution of each bacterial species per kg and mixed in a plastic bag for 1 min. The seed was inoculated in 2kg lots, then placed into paper bags and allowed to dry overnight in a dark room. Inoculated seed was placed in a cooler (ca. 4°C) until time of chemical treatment. AC Skipper, CDC Expresso and NW63 were inoculated on April 29, while Othello and Viva were inoculated on May 3.

The seed was planted on May 27 with a four-row seeder with 70cm row spacing . The plot size was 6m x 2.8m. The seed was planted at the following rates: 20 seeds/m for CDC Expresso, Othello, US1140 and Viva; 25 seeds/m for NW63 (to compensate for a germination rate of 80%); and 29 seeds/m for AC Skipper (to compensate for a gemination rate of 70%). *R. phaseoli* granular inoculant was incorporated at time of seeding at a rate of 170g per 300m of row. The treatments were arranged in a randomized complete block design with five replications. After emergence, the plots were sprayed with Odyssey DG herbicide at a rate of 14.5g per ha on June 16. The plots were sprinkler irrigated, as needed, throughout the growing season.

The emergence rate was calculated by counting all the plants in the two centre rows of each subplot during the week of June 20. Blight incidence (percentage of diseased plants) was determined by counting the total number of plants and total number of diseased plants in 2m of row for the two centre rows of each subplot during the week of August 1. Leaf blight severity (proportion of leaf area infected) was rated during the week of August 1. Severity ratings were done by selecting 50 leaves throughout the canopy in the two centre rows of each subplot. The visual assessment key for common bacterial blight developed by James (1971) was used to estimate disease severity on the leaves. The plots were undercut and threshed on October 12, and seed yields were determined for each subplot. Mean data were subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P• 0.05). Orthogonal analysis was used to compare classes of treatments between the inorganic bactericide treatments and AGRICULTURAL STREPTOMYCIN for emergence, disease severity and seed yield.

RESULTS: All six trials showed a high incidence (ca. 100%) of halo and common blight on the plants in each treatment. The majority of lesions were on the upper part of the canopy for halo blight and the lower part for common blight. While some pods in each trial had lesions, only CDC Expresso had more than 25% of the surface blighted in some treatments; therefore, a detailed assessment of disease severity on pods was done only on this cultivar.

The were no statistically significant (P• 0.05) differences between the treatments for emergence, foliar disease severity or seed yield in all six trials (Tables 1a-1f). Pod disease severity ratings on CDC Expresso did differ significantly between treatments. Orthogonal analysis revealed very few significant differences between the two groups of treatments (Tables 2a-2f). Analysis of yield data from the AC Skipper trial showed that the inorganic bactericides (nos. 1-4) produced significantly more seed than AGRICULTURAL STREPTOMYCIN (no. 6). Inorganic bactericides applied to Othello bean seed significantly improved seedling emergence compared to AGRICULTURAL STREPTOMYCIN.

CONCLUSIONS: ZINEB 80WPand BLUESTONE seed treatments did not significantly reduce the incidence or severity of bacterial blight, nor did they significantly increase seedling emergence or seed yield compared to VITAFLO-280 alone, AGRICULTURAL STREPTOMYCIN or the untreated check in these trials. However, as a group, the inorganic bactericides generally performed equal to or better than AGRICULTURAL STREPTOMYCIN. None of the chemical treatments appeared to have any significant phytotoxic effects as shown by reduced emergence or yield in comparison to the untreated check.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

Table 1a. The effect of four fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of AC Skipper dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	83.8	2.6	1112
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	87	2.7	1166
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	84.6	2.6	1155
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	84.4	2.5	1111
5. VITAFLO-280	2.6mL	83.6	2.7	973
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	80.8	2.7	919
7. Untreated Check	-	78.4	2.4	987
ANOVA (P• 0.05)		0.1618	0.3689	0.3636
Coefficient of Variation (%)		5.76	10.14	19.32

* The values in this table are the means of five replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1b. The effect of four fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of CDC Expresso dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	62	2.9	797
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	64	2.8	815
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	61.2	2.9	764
4. BLUESTONE + VITALFLO-280	2.0g + 2.6mL	63.4	2.8	817
5. VITAFLO-280	2.6mL	63.8	2.9	770
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	64.4	2.7	845
7. Untreated Check	-	67.8	2.8	851
ANOVA (P• 0.05)		0.1012	0.9287	0.8549
Coefficient of Variation (%)		5.18	9.15	14.35

* The values in this table are the means of five replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1c. The effect of four fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of NW63 dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	81	2.6	1785
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	81.2	2.4	1843
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	81.2	2.6	1753
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	79.2	2.4	1726
5. VITAFLO-280	2.6mL	82.2	2.4	1892
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	80.2	2.4	1773
7. Untreated Check	-	80.6	2.6	1687
ANOVA (P• 0.05)		0.8413	0.1354	0.8769
Coefficient of Variation (%)		3.89	7.36	13.9

* The values in this table are the means of five replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1d. The effect of four fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of Othello dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	78	1.9	2312
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	81.2	1.9	2071
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	79.6	1.9	1988
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	79.2	1.8	2094
5. VITAFLO-280	2.6mL	78.8	1.9	2279
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	70.4	2	2189
7. Untreated Check	-	76.4	2	2374
ANOVA		0.1521	0.6478	0.6382
Coefficient of Variation (%)		7.66	10.47	17.09

* The values in this table are the means of five replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1e. The effect of four fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of US1140 dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	73	2.5	1940
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	75	2.5	1964
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	76.2	2.8	1985
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	73	2.5	2084
5. VITAFLO-280	2.6mL	74.4	2.5	2076
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	72.6	2.5	1845
7. Untreated Check	-	68.2	2.7	1883
ANOVA (P• 0.05)		0.0743	0.3024	0.8808
Coefficient of Variation (%)		5.22	9.57	16.43

* The values in this table are the means of five replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1f. The effect of four fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of Viva dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	81.6	2.6	1957
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	82.6	2.6	1791
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	78.4	2.5	1815
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	78.4	2.6	1737
5. VITAFLO-280	2.6mL	79	2.4	1814
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	79.2	2.5	1754
7. Untreated Check	-	78.4	2.6	1696
ANOVA (P• 0.05)		0.1651	0.6933	0.6408
Coefficient of Variation (%)		3.71	10.23	12.31

* The values in this table are the means of five replications.

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 2a. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for AC Skipper dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	2.999	85.0 vs. 80.8
Disease severity (0-4)***	1.165	2.6 vs. 2.7
Seed yield (g/8.4m^2)	4.468	1136 vs. 987

Table 2b. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for CDC Expresso dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	0.8242	62.6 vs. 64.4
Disease severity (0-4)***	1.179	2.8 vs. 2.7
Seed yield (g/8.4m^2)	0.6472	798 vs. 844

Table 2c. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for NW63 dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	0.08192	80.6 vs. 80.2
Disease severity (0-4)***	1.146	2.5 vs. 2.4
Seed yield (g/8.4m^2)	1.072×10^{-3}	1777 vs. 1773

* These values were calculated from the totals of all five replications for each treatment.

** Test is significant when observed F is greater than required F.

*** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 2d. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for Othello dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	9.364	79.5 vs. 70.4
Disease severity (0-4)***	0.5266	1.8 vs. 2.0
Seed yield (g/8.4m^2)	0.1506	2116 vs. 2189

Table 2e. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for US1140 dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	0.7931	74.3 vs. 72.6
Disease severity (0-4)***	0.2739	2.6 vs. 2.5
Seed yield (g/8.4m^2)	1.173	1993 vs. 1845

Table 2f. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for Viva dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	0.5039	80.2 vs. 79.2
Disease severity (0-4)***	0.2022	2.6 vs 2.5
Seed yield (g/8.4m^2)	0.4145	1825 vs. 1754

* These values were calculated from the totals of all five replications for each treatment.

** Test is significant when observed F is greater than required F.

*** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

1999 PMR REPORT # 92 SECTION L: DISEASES OF FIELD LEGUMES
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris*), cvs. Othello and US1140
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (strain HB9); common blight, *Xanthomonas campestris* pv. *phaseoli* (ATTC 9563)

NAME AND AGENCY:
HOWARD R J, BURKE D A, and HUGGONS S P
Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 Fax: (403) 362-1306 Email: ron.howard@agric.gov.ab.ca

TITLE: EFFICACY OF FOUR CHEMICAL SEED TREATMENTS, COMBINED WITH A POLYMER-BASED SEED COATING, AGAINST SURFACE-BORNE HALO AND COMMON BLIGHT BACTERIA ON DRY BEANS IN FIELD TRIALS AT BROOKS, ALBERTA IN 1999.

MATERIALS: ZINEB 80WP (zineb 80% WP), BLUESTONE (copper sulfate 64% SG), AGRICULTURAL STREPTOMYCIN (streptomycin sulfate 62.6% WP; equivalent to 50% streptomycin base), VITAFLO®280 (thiram 13.2% + carbathiin 14.9% SU), NITRAGIN®SOIL IMPLANT PLUS (*Rhizobium phaseoli* [1 x 10^8 viable cells per g]), GROW-TEC INC. PROTEC POLYMER (water soluble organic polymer)

METHODS: Two types and cultivars of dry edible beans were artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria and treated with VITAFLO-280 fungicide alone, or in combination with one of the following bactericides: ZINEB 80WP at two rates, BLUESTONE at two rates, and AGRICULTURAL STREPTOMYCIN at one rate. Each of these treatments was mixed with a water-soluble, organic- polymer-based seed coating to assess if the polymer would improve the efficacy of the seed treatments. A treatment consisting of the polymer alone and an untreated check were also included. The seed was packaged into 1kg lots and sent to Grow-Tec Inc., Nisku, AB for treatment. The polymer was applied at the optium rate for each treatment and rate of planting. The seed was treated on May 25 and placed in a cooler (ca. 4°C) until planting. There was a reaction between the polymer and the BLUESTONE treatment. It darkened the mixture and reduced coverage of the seed. The polymer volume was increased for the higher (2.0g) rate of BLUESTONE.

The bean seed was artifically infested with *Psp* and *Xcp* prior to chemical treatment. Stock cultures obtained from the Agriculture & Agri-Food Canada Research Station in Lethbridge, AB, were used to inoculate nutrient broth. The resultant cultures were grown up on a rotary shaker for approximately 48 hr at room temperature, then centrifuged at 9000 rpm for 30 min and resuspended with a buffered saline solution (0.1M sodium phosphate dibasic anhydrous and 0.85% sodium chloride; pH=7.2). The concentrated solutions were measured with a hemacytometer and determined to have a density greater than 1 x 10^8 colony forming units per mL. The seed was treated with 5mL of culture solution of each bacterial species per kg and mixed in a plastic bag for one min. The seed was treated in 2kg lots. The seed was placed into paper bags and allowed to dry overnight in a dark room, then placed in a cooler (ca.

4°C) until the time of chemical treatment.

The seed was planted on June 7 with a four-row seeder with 70cm row spacing. The plot size was 6m x 2.8m. Both cultivars were planted at a rate of 20 seeds/m. *R. phaseoli* granular inoculant was incorporated at time of seeding at a rate of 170g per 300m of row. The treatments were arranged in a randomized complete block design with five replications. After emergence, the plots were sprayed with Odyssey DG herbicide at a rate of 14.5g per ha on June 16. The plots were sprinkler irrigated, as needed, throughout the growing season. The emergence rate was determined by counting all the plants in the two centre rows of each subplot during the week of June 20. Blight incidence (percentage of diseased plants) was determined by counting the total number of plants and total number of diseased plants in 2m of row for the two centre rows of each subplot during the week of August 1. Leaf blight severity (proportion of leaf area infected) was rated during the week of August 15. Severity ratings were done by selecting 50 leaves throughout the canopy in the two centre rows of each subplot. The visual assessment key for common bacterial blight developed by James (1971) was used to estimate disease severity on the leaves. The plots were undercut and threshed on October 12. Seed yields were subsequently determined for each subplot. Mean data were subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant (P• 0.05). Orthogonal analysis was used to compare treatments used in conjunction with the polymer coating vs. the polymer coating only and the untreated check.

RESULTS: Both trials showed a high incidence (ca. 100%) of halo and common blight on the plants in each treatment. The majority of lesions were on the upper part of the canopy for halo blight and the lower part for common blight. While some pods in each trial had lesions, no single treatment, on average, had more than 25% of the surface blighted; therefore, a detailed assessment of disease severity on pods was not done.

There were highly statistically significant (P• 0.01) differences in seedling emergence between some treatments in both cultivars (Tables 1a and 1b). Bean seed treated with a bactericide or fungicide in conjunction with the polymer (nos. 1-6) had a higher emergence than seed treated with the polymer alone (no. 7) or seed that was left untreated (no. 8). There were no statistically significant (P• 0.05) differences in foliar disease severity between treatments for either cultivar. The application of ZINEB 80WP and BLUESTONE to the seed significantly improve yields, compared to the check, in US1140 but not Othello. Orthogonal analysis confirmed that chemically treated seed had an average emergence that was at significantly better than the polymer only and check treatments (Tables 2a and 2b). As a group, the four chemical seed treatments significantly increased yields in US1140, but not Othello.

CONCLUSIONS: The bactericide and fungicide treatments used in this trial increased emergence by an average of 10% or more for both cultivars and increased seed yields for US1140 by up to 38%, compared to the check. The polymer was not phytotoxic to either cultivar and appeared to be an effective carrier for the bactericides and fungicides under test.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

Table 1a. The effect of eight fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of Othello dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	77.0 a	2.6	1702
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	73.0 a	2.6	1871
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	75.4 a	2.6	1661
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	74.4 a	2.7	1853
5. VITAFLO-280	2.6mL	72.0 a	2.5	1957
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	74.4 a	2.6	1697
7. Untreated Check + Polymer	-	61.8 b	2.7	1759
8. Untreated Check	-	63.6 b	2.7	1737
ANOVA (P• 0.05)		0.0001	0.946	0.4406
LSD (P=0.05)		6.14	-	-
Coefficient of Variation (%)		6.63	10.14	12.85

* The values in this table are the means of five replication. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted), and 4 = very severe (>50% blighted).

Table 1b. The effect of eight fungicidal/bactericidal seed treatments, alone or in combination, on seedling emergence, disease severity and seed yield of US1140 dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (g/8.4 m^2)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	75.2 a	2.5	1442 a
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	77.4 a	2.7	1445 a
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	80.0 a	2.5	1488 a
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	79.6 a	2.3	1420 a
5. VITAFLO-280	2.6mL	81.4 a	2.6	1551 a
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	77.6 a	2.3	1318ab
7. Untreated Check + Polymer	-	67.6 b	2.4	1452 a
8. Untreated Check	-	68.2 b	2.5	1127 b
ANOVA (P• 0.05)		0.0005	0.1787	0.0327
LSD (P=0.05)		6.51	-	232.74
Coefficient of Variation (%)		6.63	8.71	12.78

* The values in this table are the means of five replication. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 2a. Results of orthogonal analysis to compare treatments 1-6 (fungicides and bactericides combined with a polymer coating) vs. treatments 7 and 8 (polymer only and untreated check) with a required F-value of 4.26 (P• 0.05) for Othello dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	45.5	74.4 vs. 62.7
Disease severity (0-4)***	0.9707	2.6 vs. 2.7
Seed yield (g/8.4m^2)	0.2528	1790 vs. 1748

Table 2b. Results of orthogonal analysis to compare treatments 1-6 (fungicides and bactericides combined with a polymer coating) vs. treatments 7 and 8 (polymer only and untreated check) with a required F-value of 4.26 (P• 0.05) for US1140 dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	33.54	78.5 vs. 67.9
Disease severity (0-4)***	0.0479	2.5 vs. 2.5
Seed yield (g/8.4m^2)	5.526	1444 vs. 1290

* These values were calculated from the totals of all five replications for each treatment.

** Test is significant when observed F is greater than required F.

*** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

1999 PMR REPORT # 93 SECTION L: DISEASES OF FIELD LEGUMES
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris*), cvs. Othello and US1140

PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (strain HB9)
Common blight, *Xanthomonas campestris* pv. *phaseoli* (ATTC 9563)

NAME AND AGENCY:
HOWARD R J, BURKE D A, and HUGGONS S P
Alberta Agriculture, Food and Rural Development, Crop Diversification Centre South
SS#4, Brooks, Alberta, T1R 1E6
Tel: (403) 362-1328 Fax: (403) 362-1306 Email: ron.howard@agric.gov.ab.ca

MATERIALS: TEPROSYN CU (copper oxychloride 50.0% SU), TEPROSYN ZN (zinc 60.0% SU), TEPROSYN MN (manganese 50.0% SU), AGRICULTURAL STREPTOMYCIN (streptomycin sulfate 62.6% WP; equivalent to 50.0% streptomycin base), VITAFLO®280 (thiram 13.2% + carbathiin 14.9% SU), NITRAGIN®SOIL IMPLANT PLUS (*Rhizobium phaseoli* [1 x 10^8 viable cells per g])

TITLE: EFFICACY OF THREE MICRONUTRIENT SEED TREATMENTS AGAINST SURFACE-BORNE HALO AND COMMON BLIGHT BACTERIA ON DRY BEAN SEED IN FIELD TRIALS AT BROOKS, ALBERTA IN 1999

METHODS: Two types and cultivars of dry edible beans were artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria and treated with VITAFLO-280 fungicide, in combination with three micronutrients or AGRICULTURAL STREPTOMYCIN. There was also an untreated check. AGRICULTURAL STREPTOMYCIN was mixed with 3.5mL of water to form a slurry to which the fungicide suspension was added. Each micronutrient was mixed with the fungicide without any extra water. On May 31, each treatment was applied to a 1kg lot of seed. The seed was mixed with the formulation for two min, put into paper bags and allowed to dry overnight in a dark room, then placed in a cooler (ca. 4°C) until planting.

The bean seed was artificially infested with *Psp* and *Xcp* prior to chemical treatment. Stock cultures obtained from the Agriculture & Agri-Food Canada Research Centre in Lethbridge, AB, were used to inoculate nutrient broth. The resultant cultures were grown up on a rotary shaker for approximately 48 hr at room temperature. Afterwards, the cultures were centrifuged at 9000 rpm for 30 min and resuspended with a buffered saline solution (0.1M sodium phosphate dibasic anhydrous and 0.85% sodium chloride; pH=7.2). The concentrated solutions were measured with a hemacytometer and determined to have a density greater than 1 x 10^8 colony forming units per mL. On May 21, the seed was treated with 5mL/kg of culture solution of each bacterial species and mixed in a plastic bag for 1 min. The seed was treated in 2 kg lots, then placed into paper bags and allowed to dry overnight in a dark room and placed in a cooler (ca. 4°C) until time of chemical treatment.

The seed was planted on June 7 with a four-row seeder with 70cm row spacing. The plot size was 6m x 2.8m. Both cultivars were planted at a rate of 20 seeds per m. *Rhizobium phaseoli* granular inoculant was incorporated at time of planting at a rate of 170g per 300m of row. The treatments were arranged in a randomized complete block design with five replications. After emergence, the plots were sprayed with Odyssey DG herbicide at a rate of 14.5g per ha on June 16. The plots were sprinkler irrigated, as needed, throughout the growing season. The emergence rate was determined by counting all the plants in the two centre rows of each subplot during the week of June 20. Blight incidence (percentage of diseased plants) was dermined by counting the total number of plants and total number of diseased plants in two metres of row for the two centre rows of each subplot during the week of August 1. Leaf blight severity (proportion of leaf area infected) was rated during the week of August 15. Severity ratings were done by selecting 50 leaves thoughout the canopy in the two centre rows of each subplot. The visual assessment key for common bacterial blight developed by James (1971) was used to estimate disease severity on the leaves. The plots were undercut and threshed on October 22 and seed yields were determined for each subplot. Mean percentage data were subjected to ANOVA. Duncan's Multiple Tange Test was used to compare treatment means where ANOVA tests were statistically significant (P• 0.05). Orthogonal analysis was used to compare classes of treatments between seed treated with a micronutrient vs. AGRICULTURAL STREPTOMYCIN and the untreated check.

RESULTS: Both trials showed a high incidence (ca. 100%) of halo and common blight on the plants in each treatment. The majority of lesions were on the upper part of the canopy for halo blight and the lower part for common blight. While some pods in each trial had lesions, no single treatment, on average, had more than 25% of the surface blighted; therefore, a detailed assessment of disease severity was not done.

There were highly statistically significant (P• 0.01) differences in emergence between some treatments in each trial (Tables 1a and 1b). For Othello, all micronutrient-treated seed showed a higher emergence than the untreated check. For US1140, TEPROSYN ZN, TEPROSYN MN and AGRICULTURAL STREPTOMYCIN treatments had a higher emergence than TEPROSYN CU and the untreated check. There were no statistically significant differences (P• 0.05) for foliar disease severity or seed yield. Orthogonal analysis showed that the micronutrient treatments, as a group, had higher emergence values than AGRICULTURAL STREPTOMYCIN and the untreated check for both trials (Tables 2a and 2b).

CONCLUSIONS: The three micronutrient seed treatments evaluated in this study exhibited bactericidal/fungicidal properties as evidenced by increased emergence (ca. 5%) for both cultivars. TEPROSYN CU had a marked phytotoxic effect on US1140, but only a slight effect on Othello. Although none of the micronutrient treatments significantly reduced leaf blight severity or increased yield, TEPROSYN ZN and TEPROSYN MN performed as well as, if not slightly better than, AGRICULTURAL STREPTOMYCIN, the standard seed treatment bactericide for combating halo blight and common blight on dry beans in Canada and the United States.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458, Agric. Canada, Ottawa.

Table 1a. The effect of three micronutrient seed treatments on seedling emergence, disease severity and seed yield of Othello dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease Severity (0-4)**	Yield (g/8.4 m^2)
1. TEPROSYN CU + VITAFLO-280	3.0mL + 2.0mL	77.8 a	2.8	1315
2. TEPROSYN ZN + VITAFLO-280	6.0mL + 2.6mL	80.0 a	2.6	1503
3. TEPROSYN MN + VITAFLO-280	3.0mL + 2.6mL	79.8 a	2.8	1428
4. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	75.2 a	2.8	1434
5. Untreated Check	-	69.0 b	2.7	1375
ANOVA (P• 0.05)		0.0024	0.7171	0.8556
LSD (P=0.05)		5.28	-	-
Coefficient of Variation (%)		5.16	7.12	19.48

* The values in this table are the means of five replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test (P• 0.05).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1b. The effect of three micronutrient seed treatments on seedling emergence, disease severity and seed yield of US1140 dry beans in a field trial at Brooks, Alberta in 1999.*

Treatment	Rate of product /kg seed	Emerg-ence (%)	Disease Severity (0-4)**	Yield (g/8.4 m^2)
1. TEPROSYN CU + VITAFLO-280	3.0mL + 2.6mL	65.0 b	2.6	1385
2. TEPROSYN ZN + VITAFLO-280	6.0mL + 2.6mL	78.0 a	2.6	1714
3. TEPROSYN MN + VITAFLO-280	3.0mL + 2.6mL	80.4 a	2.7	1436
4. AGRICULTURAL STREPTOMYCIN + VITALFLO-280	1.0g + 2.6mL	75.2 a	2.7	1627
5. Untreated Check	-	64.6 b	2.7	1605
ANOVA (P• 0.05)		0	0.9558	0.3158
LSD (P=0.05)		5.43	-	-
Coefficient of Variation (%)		5.58	9.5	17.47

* The values in this table are the means of five replications. Numbers within a column followed by the same small letter are not significantly different according to a Duncan's Multiple Range Test (P• 0.05).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 2a. Results of orthogonal analysis to compare treatments 1, 2 and 3 (micronutrient treatments) vs. treatments 4 and 5 (AGRICULTURAL STREPTOMYCIN and untreated check) with a required F-value of 4.49 (P• 0.05) for Othello dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	19.49	79.2 vs. 72.1
Disease severity***	4.482×10^{-3}	2.7 vs. 2.7
Seed yield (g/8.4m^2)	8.864×10^{-3}	1415 vs. 1405

Table 2b. Results of orthogonal analysis to compare treatments 1, 2 and 3 (micronutrient treatments) vs. treatments 4 and 5 (AGRICULTURAL STREPTOMYCIN and untreated check) with a required F-value of 4.49 (P• 0.05) for US1140 dry beans in a field trial at Brooks, Alberta in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	7.623	74.5 vs. 69.9
Disease severity (0-4)***	0.2777	2.7 vs. 2.7
Seed yield (g/8.4m^2)	0.8824	1512 vs. 1616

* These values were calculated from the totals of all five replications for each treatment.

** Test is significant when observed F is greater than required F.

*** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

1999 PMR REPORT # 94 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 93000482

CROP: Dry bean (*Phaseolus vulgaris*), cvs. NW63 and Viva
PEST: Halo blight, *Pseudomonas syringae* pv. *phaseolicola* (strain HB9)
Common blight, *Xanthomonas campestris* pv. *phaseoli* (ATTC 9563)

NAME AND AGENCY:
HOWARD R J, BURKE D A and HUGGONS S P
Alberta Agriculture, Food and Rural Development, Crop Diversification South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1328 Fax: (403) 362-1306 Email: ron.howard@agric.gov.ab.ca

HOGG T J and PEDERSON M R
Saskatchewan Irrigation Diversification Centre
Box 700, Outlook, Saskatchewan S0L 2N0
Tel: (306) 867-5405 Fax: (306) 867-9656 Email: pf22405@em.agr.ca

MATERIALS: ZINEB 80WP (zineb 80% WP), BLUESTONE (copper sulfate 64% WP), AGRICULTURAL STREPTOMYCIN (62.6% streptomycin sulfate WP; equivalent to 50.0% streptomycin base), VITAFLO®280 (thiram 13.2% + carbathiin 14.9% WP), SELF-STICK™ (*Rhizobium leguminosarum* biovar *phaseoli* [1 x 10^9 viable cell per g])

TITLE: EFFICACY OF FOUR CHEMICAL SEED TREATMENTS AGAINST SURFACE-BORNE HALO AND COMMON BLIGHT BACTERIA ON DRY BEANS IN FIELD TRIALS AT OUTLOOK, SASKATCHEWAN IN 1999

METHODS: Two types and cultivars of dry edible beans were artificially infested with halo blight (*Psp*) and common blight (*Xcp*) bacteria and treated with the fungicide VITAFLO-280 alone, or in combination with one of the following bactericides: ZINEB 80WP at two rates, BLUESTONE at two rates and, AGRICULTURAL STREPTOMYCIN at one rate. There was also an untreated check. On May 12, the seed was treated in 1kg lots. Each bactericide was combined with 3.5mL of water to form a slurry to which was added 2.6mL of liquid fungicide. The seed was mixed with the chemical formulation for two min, then placed in paper bags and allowed to dry overnight in a dark room. The treated seed was stored in a cooler (ca 4°C) until planting.

The bean seed was artificially infested with *Psp* and *Xcp* prior to chemical treatment. Stock cultures obtained from the Agriculture & Agri-Food Canada Research Centre in Lethbridge, AB, were used to inoculate nutrient broth. The resultant cultures were grown up on a rotary shaker for approximately 48 hours at room temperature. Afterwards, they were centrifuged at 9000 rpm for 30 minutes and resuspended with a buffered saline solution (0.1M sodium phosphate dibasic anhydrous and 0.85% sodium chloride; pH=7.2). The concentrated solutions were measured with a hemacytometer and determined to have a density greater than 1 x 10^8 colony forming units per mL. The seed was treated with 5mL of culture solution of each bacterial species per kg and mixed in a plastic bag for 1 min. The seed was inoculated in 2kg lots, then placed into paper bags and allowed to dry overnight in a dark room.

Inoculated seed was placed in a cooler (ca. 4°C) until time of chemical treatment. The seed was inoculated on April 29.

The seed was planted on May 28 with a four-row seeder with 60cm row spacing using. The plot size was 7.88m x 2.44m (which was later cut back to 3.66m x 2.44m). The seed was planted in conjunction with Self-Stick™ at a rate of 1g of inoculant per 818g of seed. The Viva was planted at a rate of 20/per m and the NW63 was planted at a rate of 25 seeds/m (to compensate for a germination rate of 80%). The treatments were arranged in a randomized complete block design with five replications. After emergence, the plots were sprayed with Basagran herbicide at a rate of 1.75L per ha on June 30. The plots were sprinkler irrigated, as needed throughout the growing season.

The emergence rate was calculated by counting all the plants in the two centre rows of each subplot during the week of July 4. Blight incidence (percentage of diseased plants) was determined by counting the total number of plants and total number of diseased plants in two meters of row for the two centre rows of each subplot during the week of August 1. Leaf blight severity (proportion of leaf area infected) was rated during the week of August 8. Severity ratings were done by selecting 50 leaves throughout the canopy in the two centre rows of each subplot. The visual assessment key for common bacterial blight developed by James (1971) was used to estimate disease severity on the leaves. The plots were threshed during the week of October 3, and seed yields were subsequently determined for each subplot. Mean data were subjected to ANOVA. Duncan's Multiple Range Test was used to compare treatment means where ANOVA tests were statistically significant. Orthogonal analysis was used to compare classes of treatments between the inorganic bactericide treatments and AGRICULTURAL STREPTOMYCIN for emergence, disease severity and seed yield.

RESULTS: Both trials showed a high incidence (ca. 100%) of halo and common blight on the plants in each treatment. The majority of lesions were on the upper part of the canopy for halo blight and the lower part for common blight. While some pods in each trial had lesions, no single treatment, on average, had more than 25% of the surface blighted; therefore, a detailed assessment of disease severity on pods was not done.

There were no statistically significant (P• 0.05) differences between treatments for emergence and foliar disease severity in either trial or for yield in Viva (Tables 1a and 1b). For NW63, there were significant differences in yield between some treatments. AGRICULTURAL STREPTOMYCIN (no. 6) yielded less than all other treatments, including the untreated check. Furthermore, ZINEB 80WP (no. 1) at the lower rate had a lower seed yield than BLUESTONE (no. 4) at the higher rate. For NW63, orthogonal analysis showed that the inorganic bactericide treatments (nos. 1-4) had a significantly higher yield than did AGRICULTURAL STREPTOMYCIN (Tables 2a and 2b).

CONCLUSIONS: The four inorganic bactericide treatments did not significantly reduce the incidence or severity of bacterial blight, nor did they significantly increase the emergence when compared to VITAFLO-280 alone, AGRICULTURAL STREPTOMYCIN or the untreated check. However, in NW63, the inorganic bactericide treatments yielded 14% more, on average, than AGRICULTURAL STREPTOMYCIN. None of the chemical treatments appeared to have any significant phytotoxic effects as reflected by emergence and yield data.

REFERENCE: James, W.C. 1971. A manual of assessment keys for plant diseases. Publ. 1458,

Agric. Canada, Ottawa.

Table 1a. The effect of four fungicidal/bactericidal seed treatments on seedling emergence, disease severity and seed yield of NW63 dry beans in a field trial at Outlook, Saskatchewan in 1999.*

Treatment	Rate of product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (kg/ha)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	78.2	2.9	1915 b
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	77.8	3	2054 ab
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	77.6	3	1944 ab
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	82	3.3	2099 a
5. VITAFLO-280	2.6mL	77.4	3.1	1942 ab
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	79.2	3.2	1755 c
7. Untreated Check	-	78.4	3	1966 ab
ANOVA (P• 0.05)		0.629	0.0771	0.0061
LSD (P=0.05)		-	-	159.76
Coefficient of Variation (%)		5.29	6.44	6.26

* The values in this table are the means of five replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 1b. The effect of four fungicidal/bactericidal seed treatments on seedling emergence, disease severity and seed yield of Viva dry beans in a field trial at Outlook, Saskatchewan in 1999.*

Treatment	Rate of Product /kg seed	Emergence (%)	Disease severity (0-4)**	Yield (kg/ha)
1. ZINEB 80WP + VITAFLO-280	1.5g + 2.6mL	84.8	2.9	2574
2. ZINEB 80WP + VITAFLO-280	2.0g + 2.6mL	82.2	3	2562
3. BLUESTONE + VITAFLO-280	1.5g + 2.6mL	-	-	-
4. BLUESTONE + VITAFLO-280	2.0g + 2.6mL	81.2	3	2344
5. VITAFLO-280	2.6mL	84.6	3.1	2603
6. AGRICULTURAL STREPTOMYCIN + VITAFLO-280	1.0g + 2.6mL	80.8	3	2512
7. Untreated Check	-	84.2	2.9	2650
ANOVA (P• 0.05)		0.08	0.925	0.4819
Coefficient of Variation (%)		3.15	8.03	9.75

* The values in this table are the means of five replications. Numbers within a column followed by the same small letter are not significantly different according to Duncan's Multiple Range Test (P• 0.05).

** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Table 2a. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for NW63 dry beans in a field trial at Outlook, Saskatchewan in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	0.02082	78.9 vs. 79.2
Disease severity (0-4)***	2.239	3.1 vs. 3.2
Seed yield (g/8.4m^2)	16.46	2003 vs. 1755

Table 2b. Results of orthogonal analysis to compare treatments 1, 2, 3 and 4 (ZINEB 80WP and BLUESTONE) vs. treatment 6 (AGRICULTURAL STREPTOMYCIN) with a required F-value of 4.26 (P• 0.05) for Viva dry beans in a field trial at Outlook, Saskatchewan in 1999.*

Parameter	Observed F-value**	Group means
Emergence (%)	2.05	82.7 vs. 80.8
Disease severity (0-4)***	2.902×10^{-3}	3.0 vs. 3.0
Seed yield (g/8.4m^2)	0.02612	2493 vs. 2512

* These values were calculated from the totals of all five replications for each treatment.

** A test is significant when observed F is greater than required F.

*** Severity rating: 0 = no disease, 1 = slight (1-10% leaf or pod area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

1999 PMR REPORT # 95 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Chickpea, (*Cicer arietinum* L.), cv. B-90
PEST: Root rot, *Fusarium avenaceum* (Fr.) Sacc.

NAME AND AGENCY:
CHANG K F, HOWARD R J and BRIANT M A
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

TITLE: **COMPARISON OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF FUSARIUM ROOT ROT OF CHICKPEA IN ALBERTA IN 1999**

MATERIALS: MAXIM 480 (fludioxonil 480g/L FS), APRON XL (metalaxyl-M 369 g ai/L LS), APRON MAXX 240.5 (metalaxyl-M, 13.6%+fludioxonil, 9.11% MEC), DIVIDEND (difenoconazole, 32.8% FS), ADAGE (47.6% FS), VITAFLO 280 (carbathiin 14.9%, thiram 13.2% SU), HELIX GREEN 156 FS (thiamethoxam, 156 g/L FS)

METHODS: Chickpea cv. B-90 was treated in a Hege small batch seed treater with APRON XL and APRON MAXX at 3.75 and 7.5 g ai/100 kg seed, MAXIM alone at 2.5 g ai/ 100 kg seed and combined with APRON XL at 3.75 and 7.5 g ai/100 kg seed, a combination of MAXIM, APRON, and DIVIDEND at 2.5, 7.5 and 12 g ai/100 kg seed, respectively, alone and combined with ADAGE at 25 and 50 g ai/100 kg seed as well as with HELIX GREEN at 200 g ai/100 kg seed. Seed was also treated with VITAFLO 280 at 88 g ai/100 kg seed. An experimental plot was established on 25 May, 1999 at Brooks, Alberta, in brown chernozemic clay-loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 30 cm apart. Seeds were planted 5 cm deep at a rate of 75 per row. *Fusarium avenaceum* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 20 mL/row (2.5×10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls. Emerged seedlings were counted along 2 m of the middle two rows, 3 weeks after seeding. At maturity (October 9), plants were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Results are presented in Table 1. All seed treatments except APRON XL at the higher rate significantly (*P*• 0.05) increased emergence over the inoculated control. Combinations including MAXIM or APRON MAXX all produced significantly (*P*• 0.05) greater emergence than APRON XL, VITAFLO 280 or MAXIM alone. All treatments except the two rates of APRON XL showed higher seed yield than the inoculated or noninoculated controls. Treatments where ADAGE or HELIX GREEN were included in the formulation had significantly (*P*• 0.05) higher seed yields than those without, except for APRON MAXX at the higher rate.

CONCLUSIONS: APRON MAXX and the MAXIM-APRON-DIVIDEND combinations showed the greatest positive impact on seedling emergence. For seed yield, the greatest improvements over the controls was observed for APRON MAXX at the higher rate and for the MAXIM-APRON-DIVIDEND combinations where ADAGE or HELIX GREEN was included in the formulation.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of chickpea cv. B-90 at Brooks, Alberta in 1999.

Treatment	Rate (g ai/100 kg seed)	No. seedlings /5 m	Yield g /5m^2
Control	--	34.2 bc*	57.5 e
Control+*Fusarium* (*F*)	--	17.0 e	48.8 e
APRON XL+*F*	3.75	23.2 d	60.9 e
APRON XL+*F*	7.5	20.7 de	60.0 e
MAXIM+*F*	2.5	30.2 c	113.0 d
APRON XL+ MAXIM+*F*	7.5 + 2.5	42.8 a	144.5 cd
APRON MAXX+*F*	3.75	41.7 a	139.3 cd
APRON MAXX+*F*	7.5	42.7 a	170.2 bc
AMD† +*F*	7.5+2.5+12	41.4 a	112.3 d
AMD+ADAGE+*F*	7.5+2.5+12+25	43.1 a	196.6 ab
AMD+ADAGE+*F*	7.5+2.5+12+50	41.3 a	230.7 a
AMD+HELIX GREEN+*F*	7.5+2.5+12+200	44.1 a	211.3 ab
VITAFLO 280 +*F*	88	34.5 b	108.6 d

* Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

† APRON XL+ MAXIM+ DIVIDEND

1999 PMR REPORT # 96 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Chickpea (*Cicer arietinum* L.), cv. B-90
PEST: Root rot, *Pythium ultimum* Trow, *P. irregulare* Buisman

NAME AND AGENCY:

CHANG K F, HOWARD R J and BRIANT M A
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF PYTHIUM ROOT ROT OF CHICKPEA IN ALBERTA IN 1999

MATERIALS: MAXIM 480 (fludioxonil 480g/L FS), APRON XL (metalaxyl-M 369 g ai/L LS), APRON MAXX 240.5 (metalaxyl-M, 13.6%+fludioxonil, 9.11% MEC), DIVIDEND (difenoconazole, 32.8% FS), ADAGE (47.6% FS), VITAFLO 280 (carbathiin 14.9%, thiram 13.2% SU), HELIX GREEN 156 FS (thiamethoxam, 156 g/L FS)

METHODS: Chickpea cv. B-90 was treated in a Hege small batch seed treater withAPRON XL and APRON MAXX at 3.75 and 7.5 g ai/100 kg seed, MAXIM alone at 2.5 g ai/ 100 kg seed and combined with APRON XL at 3.75 and 7.5 g ai/100 kg seed, a combination of MAXIM, APRON, and DIVIDEND at 2.5, 7.5 and 12 g ai/100 kg seed, respectively, alone and combined with ADAGE at 25 and 50 g ai/100 kg seed as well as with HELIX GREEN at 200 g ai/100 kg seed. Seed was also treated with VITAFLO 280 at 88 g ai/100 kg seed. An experimental plot was established on 25 May, 1998 at Brooks, Alberta, in brown chernozemic clay loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 30 cm apart. Seeds were planted 5 cm deep at a rate of 75 per row. *Pythium ultimum* and *P. irregulare* were grown on sterilized oat grains for 14 days, dried, ground, mixed and incorporated at the time of seeding at the rate of 40 mL/row (5×10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls Emerged seedlings were counted along 2 m of the middle two rows, 3 weeks after seeding. At maturity (October 9), plants were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: All seed treatments, except MAXIM alone, significantly (*P*• 0.05) increased seedling emergence over the inoculated control (Table 1). The APRON, APRON MAXX and MAXIM-APRON combinations significantly (*P*• 0.05) improved emergence over both inoculated and noninoculated controls, over MAXIM and over VITAFLO 280. Seed yield was significantly (*P*• 0.05) improved over the inoculated control by APRON XL at the higher rate, APRON MAXX at both rates, and by all MAXIM-APRON-DIVIDEND combinations, except where ADAGE was included at the higher rate. APRON MAXX at the lower rate and the MAXIM-APRON-DIVIDEND combination alone, or in combination with HELIX GREEN, also significantly (*P*• 0.05) improved seed yield over VITAFLO 280 and MAXIM alone.

CONCLUSIONS: Seedling emergence was improved by all fungicide seed treatments, except MAXIM alone. Treatment with VITAFLO 280 or MAXIM resulted in lower seedling emergence than all other seed treatments in the trial. These two treatments also resulted in lower seed yield than APRON MAXX at the lower rate and the MAXIM-APRON-DIVIDEND combination, alone or with HELIX GREEN.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of chickpea cv. B-90 at Brooks, Alberta in 1999.

Treatment	Rate (g ai/100 kg seed)	No. seedlings /6 m	Yield g $/5m^2$
Control	--	34.5 b[*]	96.0 abcd
Control+*Pythium* (*P*)	--	22.0 c	56.6 d
APRON XL+*P*	3.75	40.6 a	78.5 abcd
APRON XL+*P*	7.5	40.5 a	116.8 ab
MAXIM+*P*	2.5	24.8 c	66.8 cd
APRON XL+ MAXIM+*P*	7.5 + 2.5	43.5 a	77.0 bcd
APRON MAXX+*P*	3.75	43.2 a	129.7 a
APRON MAXX+*P*	7.5	41.9 a	104.2 abc
AMD[†]+*P*	7.5+2.5+12	41.6 a	116.8 ab
AMD+ADAGE+*P*	7.5+2.5+12+25	43.6 a	108.0 abc
AMD+ADAGE+*P*	7.5+2.5+12+50	43.4 a	76.4 bcd
AMD+HELIX GREEN+*P*	7.5+2.5+12+200	43.7 a	117.5 ab
VITAFLO 280 +*P*	88	32.7 b	64.2 cd

[*] Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

[†] APRON XL+ MAXIM+ DIVIDEND

1999 PMR REPORT # 97 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Chickpea (*Cicer arietinum* L.), cvs. Sanford and Tyson
PEST: Root rot, *Rhizoctonia solani* Kühn

NAME AND AGENCY:
CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 Fax: (403) 362-1326 Email: changk@agric.gov.ab.ca

HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax: (780) 632-8612 Email: hwang@arc.ab.ca

TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS TO CONTROL RHIZOCTONIA ROOT ROT OF CHICKPEA IN 1999

MATERIALS: APRON (metalaxyl, 317 g/L SN), VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU),U2727, LO 176

METHODS: Seed of chickpea cvs. Sanford and Tyson was treated with VITAFLO 280, U2727 and LO 176 in a Hege II small batch seed treater at the rates given in Table 1. Experimental plots were established on 26 May at Brooks, Alberta in brown chernozemic clay-loam soil. Plots were seeded in a split-plot randomized complete block design with four replications with chickpea cultivars serving as main plots and fungicide seed treatment, along with *Rhizoctonia*-inoculated and non-inoculated controls, serving as subplots. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 5 cm deep at a rate of 75 per row. *Rhizoctonia solani* was grown on a mixture of sterilized oat and rye kernels for 14 days, dried, ground and incorporated as inoculum at the rate of 30 mL/row at the time of seeding. Emerged seedlings were counted for each subplot on 18 June. At maturity (11 October), plants from each plot, discounting a 0.5 m section from each end, were harvested by small plot combine. Seeds weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Treatment with VITAFLO 280 and U2727 significantly (*P*• 0.05) improved seedling emergence and seed yield over the inoculated control (Table 1). Emergence levels were similar for both cultivars but seed yield was significantly (*P*• 0.05) greater for cv. Sanford than for cv. Tyson (Table 2).

CONCLUSIONS: Application of VITAFLO 280 and U2727 improved both seedling emergence and seed yield; application of LO 176 did not improve either parameter over the nontreated control.

Table 1. Effects of fungicidal seed treatments on seedling survival and seed yield of chickpea cvs.Sanford and Tyson at Brooks, Alberta in 1999.

Treatment	Rate (mL/kg seed)	Plants/6m	Seed yield (g/5 m^2)
VITAFLO+APRON +*R*†	3.3 + 5	32.4 a	986.3 a
U2727+APRON+*R*	4.0 + 5	11.8 c	771.7 a
LO 176+APRON+*R*	1.25 + 5	6.5 d	276.8 bc
LO 176+APRON+*R*	2.5 + 5	4.5 d	269.6 bc
Control+*R*	--	3.2 d	137.0 c
Control	--	23.4 b	491.2 b

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (*P*• 0.05).

† Denotes inoculation with *Rhizoctonia solani.*

Table 2. Comparison of seedling establishment and seed yield of chickpea cvs. Sanford and Tyson at Brooks, Alberta in 1999.

Cultivar	Plants/6m	Seed yield (g/5 m^2)
Sanford	13.0 a	763.9 a
Tyson	14.3 a	213.6 b

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P• 0.05).

1999 PMR REPORT # 98 **SECTION L: DISEASES OF VEGETABLES AND SPECIAL CROPS**
STUDY DATA BASE: 375-1122-9612

CROP: Chickpea (*Cicer arietinum* L.) cvs. Sanford (kabuli type), Myles, Arizona (desi type).
PEST: Ascochyta blight, *Ascochyta rabiei* (Pass.) Lab.

NAME AND AGENCY:

CHONGO G, GOSSEN B D, and BUCHWALDT L
Agriculture and Agri-Food Canada, Saskatoon Research Centre, Saskatoon, Saskatchewan, S7N 0X2
Tel: (306) 956-7200 Fax: (306) 956-7247 Email: Chongog@em.agr.ca
LAFOND G.
Agriculture and Agri-Food Canada, Indian Head Research Station, Saskatchewan, S7N 0X2
Tel: (306) 695 5220 Fax: (306) 695-3445 Email: Lafond@swift.ihres.ca

TITLE: EFFECT OF BRAVO AND QUADRIS ON ASCOCHYTA BLIGHT AND YIELD OF CHICKPEA IN 1998

MATERIALS: BRAVO 500 (chlorothalonil 500 g/L), QUADRIS (azoxystrobin 250 g/L)

METHODS: Five small-plot trials were conducted in Saskatchewan in 1998 to evaluate the effectiveness of various timing and rates of application of BRAVO and QUADRIS fungicides on ascochyta blight severity and yield of chickpea. Trials were conducted at the AAFC research farms at Saskatoon, Swift Current and Indian Head, and in commercial fields at Elrose and Sovereign. The partially resistant cv. Sanford was assessed at Swift Current, Indian Head and Sovereign, cv. Myles (partially resistant) at Elrose and cv. Arizona (susceptible) at Saskatoon. A randomized complete block design with four replications was used at each site, and each plot was 6 x 2.4 m. The treatments included: untreated check, 1.0 kg a.i./ha BRAVO applied once (early flowering), twice (early and mid-flowering) and three times (early, mid- and late-flowering); QUADRIS at 125 and 175 g a.i./ha once (early flowering) and twice (early and mid-flowering). Fungicides were applied in 200 L/ha spray volume using a hand-held sprayer with Tee-Jet 8003 VS nozzles at 275 kPa. Ascochyta blight severity was rated two weeks after spraying using the Horsfall-Barratt scale (0-11). Analysis of variance (General Linear Model Procedure, SAS) was used to analyze disease and yield data. The LSD test was used for comparison of means.

RESULTS: In the untreated controls, ascochyta severity was 8-9% in Sanford, 19% in Myles and 57% in the susceptible cv. Arizona (Table 1). Both BRAVO and QUADRIS reduced (P • 0.05) ascochyta severity in Sanford at Indian Head and Swift Current (Table 1). Small increases in yield (P • 0.05) were observed in some treatments of both fungicides (Table 2), but there was no consistent differences from the untreated control.

CONCLUSIONS: Yields were high at Indian Head (cv. Sanford) and in the commercial fields at Elrose (cv Myles) and Sovereign (cv Sanford). Late/multiple applications of fungicide generally increased seed yield in these two partially resistant cultivars, but a single early application had no effect. This suggests that resistance in cv. Sanford may decline as the plants mature. Yields were low at Swift Current and fungicide treatments had no effect. Despite the high levels of disease in the susceptible cv. Arizona, fungicide application did not increase yield.

Acknowledgments: Technical support by Ken Bassendowski and help from summer students appreciated. Financial support provided by Agri-Food Innovation Fund.

Table 1. Effect of foliar application of BRAVO 500 and QUADRIS on ascochyta blight severity (%) on chickpea at 5 sites in Saskatchewan in 1998.

Fungicide	Rate	No. of applns[1]	Elrose	Indian Head	Swift Current	Sovereign	Saskatoon
Untreated	---	0	19	8 b	8 b	9	57
BRAVO	1.5 kg a.i./ha	1	19	4 b	7 ab	8	32
BRAVO	1.5	2	14	4 b	5 b	11	45
BRAVO	1.5	3	21	-	-	12	37
QUADRIS	125 g a.i./ha	1	21	6 ab	5 b	9	37
QUADRIS	125 g	2	13	5 ab	6 ab	9	31
QUADRIS	175 g	1	12	-	6 ab	12	39
QUADRIS	175 g	2	16	-	5 b	9	48
$LSD_{0.05}$			ns	3	3	ns	ns
Contrasts		DF					
Untreated vs fungicide		1	ns	**	[2]	ns	ns
Untreated vs BRAVO		1	ns	**	[2]	ns	ns
Untreated vs QUADRIS		1	ns	[2]	[2]	ns	ns
BRAVO vs QUADRIS		1	ns	ns	ns	ns	ns

Fungicide application: 1, at early flower; 2, early and mid-flower; 3, early, mid- and late-flower.
Cvs: Sanford at Indian Head, Swift Current and Sovereign, Myles at Elrose, and Arizona at Saskatoon.

[1] Number of applications.

[2],** Significant at P=0.05 an P• 0.01, respectively. Means in columns with same letters are not significantly different, P=0.05.

Table 2. Effect of foliar applications of BRAVO 500 and QUADRIS on seed yield (Mg/ha) of chickpea at five sites in Saskatchewan in 1998.

Fungicide	Rate	No. of applns[1]	Elrose	Indian Head	Swift Current	Sovereign	Saskatoon
Untreated	---	0	1.28dc	3.25	0.67	1.25 b	0.67
BRAVO	1.5 kg a.i./ha	1	1.15d	3.47	0.65	1.29 b	0.86
BRAVO	1.5	2	1.67a	3.67	0.52	1.38 ab	0.88
BRAVO	1.5	3	1.41abcd	-	-	1.37 ab	0.85
QUADRIS	125 g a.i./ha	1	1.31bcd	3.46	0.54	1.29 b	0.87
QUADRIS	125 g	2	1.52abc	3.46	0.63	1.56 a	0.99
QUADRIS	175 g	1	1.44abcd	-	0.48	1.42 ab	0.97
QUADRIS	175 g	2	1.62ab	-	0.63	1.35 ab	0.93
$LSD_{0.05}$			0.33	ns	ns	0.22	ns

Fungicide application: 1, at early flower; 2, early and mid-flower; 3, early, mid- and late-flower.
Cvs: Sanford at Indian Head, Swift Current and Sovereign, Myles at Elrose, and Arizona at Saskatoon.
Means in columns with same letters are not significantly different, *P*=0.05. Mg/ha = '000s of kg/ha.

[1] Number of applications.

1999 PMR REPORT # 99 **SECTION L: DISEASES OF VEGETABLES/SPECIAL CROPS**
STUDY DATA BASE: 375 1122 9612

CROP: Chickpea (*Cicer arietinum* L.), cvs. Sanford (Kabuli type) and Myles (Desi type)
PEST: Ascochyta blight, *Ascochyta rabiei* (Pass.) Lab.

NAME AND AGENCY:
CHONGO G, GOSSEN B D and BUCHWALDT L
107 Science Place, Agriculture and Agri-Food Canada, Saskatoon, Saskatchewan, S7N 0X2.
Tel: (306) 956 2820 Fax: (306) 956 7247 Email: chongog@em.agr.ca

TITLE: FUNGICIDAL CONTROL OF ASCOCHYTA BLIGHT IN CHICKPEA IN 1999

MATERIALS: BRAVO 500 (500 g/L w/w chlorothalonil), QUADRIS (azoxystrobin 250 g/L), BRAVO ULTREX (chlorothalonil 825 g/L).

METHODS: Two field trials were established in commercial chickpea fields in Saskatchewan in 1999. The fields had been seeded to partially resistant cvs. Myles at Harris (May 4) and Sanford at Zealandia (May 3). Plots size was 6 x 4 m, with 1-m pathways between plots, arranged in a randomized complete block design. The treatments were: a nontreated control; fungicide application at early flower only (July 6 in cv. Sanford and July 14 in cv. Myles)–BRAVO 500 at 1.5 ka ai/ha, BRAVO ULTREX at 1.0 kg ai/ha or QUADRIS at 175 g ai/ha; lower rates of BRAVO 500 at 1 kg ai/ha and QUADRIS at 125 g ai/ha applied at early flower; lower rates of BRAVO 500 at 1 kg ai/ha and QUADRIS at 125 g ai/ha applied at late flower (10-14 days later, Jul 19 in cv. Sanford and July 29 in cv. Myles), and early + late–BRAVO 500 at 1.0 kg ai/ha or QUADRIS (125 g ai/ha); and combinations of fungicides–1 kg ai/ha BRAVO 500 early and 125 g ai/ha QUADRIS late, or 125 g ai/ha QUADRIS early and 1kg ai/ha BRAVO 500 late.

Fungicides were applied in 200 L/ha spray volume using a bicycle sprayer equipped with Tee-Jet 8003 VS nozzles at 275 kPa. Ascochyta blight severity was rated prior to each fungicide application and a final rating was done one month after the second spray (August 19 in cv. Sanford and August 29 in cv. Myles). Ratings using the Horsfall-Barratt scale (0-11) were converted to percent disease severity.

RESULTS: In the first disease rating, ascochyta blight severity was low and ranged from 2-4% in cv. Myles and 1-3% in cv. Sanford. By the second rating, ascochyta blight in nontreated control plots increased significantly in cv. Myles to 72% but only up to 14% in cv. Sanford (disease data for the first and second ratings not shown). In the third and final disease ratings, ascochyta blight severity in nontreated control plots ranged up to 93% in cv. Myles and 86% in cv. Sanford.(Table 1). Fungicide application reduced disease severity and increased seed yield in both cultivars. Two applications of BRAVO 500 or QUADRIS, or a combination of BRAVO 500 and QUADRIS were the most effective. The combination of BRAVO 500 followed by QUADRIS produced the highest seed yield in both cultivars. Ascochyta blight control from a single application of BRAVO ULTREX at early flowering was poor and seed yield was low.

CONCLUSIONS: Ascochyta blight of chickpea was severe across Saskatchewan in 1999, even in partially resistant cultivars like Myles and Sanford, due to highly favourable weather conditions during much of the growing season. Single applications of fungicide reduced disease severity. However, two applications of BRAVO 500 at 1 kg a.i./ha or QUADRIS at 125 g a.i./ha, as well as combinations of BRAVO 500 and QUADRIS, (especially BRAVO at early flowering followed by QUADRIS) were required to reduce ascochyta blight severity to acceptable levels and to increased seed yield under this severe disease pressure.

ACKNOWLEDGEMENTS: Thanks to the Agri-Food Innovation Fund and Zeneca for financial support and to K. Bassendowski and the summer student crew for excellent technical assistance.

Table 1. Effect of foliar application of BRAVO 500, BRAVO ULTREX and QUADRIS on ascochyta blight severity (%) and seed yield (kg ha^{-1}) in chickpea in two commercial fields in Saskatchewan, 1999.

Fungicide	Rate	Timing [†]	Harris		Zealandia	
			Severity [††]	Seed yield	Severity [††]	Seed yield
Nontreated control	--		93 a	45 c	86 a	245 d
BRAVO 500	1 kg/ha	Early[‡]	77 bc	407 bc	48 b	433 d
BRAVO 500	1 kg/ha	Late	84 ab	255 c	37 bc	476 d
BRAVO 500	1.5 kg/ha	Early	67 cd	374 bc	32 bcd	420 d
BRAVO 500	1 kg/ha	Early + Late	33 f	806 ab	7 de	896 bc
QUADRIS	125 g/ha	Early	77 bc	539bc	29 bcde	422 d
QUADRIS	125 g/ha	Late	77 bc	392 bc	16cde	1000 abc
QUADRIS	175 g/ha	Early	84 ab	246 c	45 b	251 d
QUADRIS	125 g/ha	Early + Late	28 f	823 ab	4 e	1185 ab
BRAVO ULTREX		Early	81 ab	557 bc	50 b	384 d
BRAVO + QUADRIS		Early + Late	56 de	1242 a	5 e	1276 a
QUADRIS + BRAVO		Early + Late	50 e	433 bc	6 de	848 c
$LSD_{0.05}$			13	524	27	304

[†] Fungicide application: early-flowering (July 6 in cv. Sanford and July 14 in cv. Myles), late-flowering 10-14 days later (July 19 in cv. Sanford and July 29 in cv. Myles).

[‡] Means in a column followed with the same letter do not differ based on LSD at *P* • 0.05.

[††] Third and final disease rating (August 19 in cv. Sanford and August 29 in cv. Myles).

CROP: Lentil (*Lens culinaris* Medik.) cv. Laird

PEST: Anthracnose (*Colletotrichum truncatum* (Schwein.) Andrus & Moore)
Ascochyta blight (*Ascochyta lentis* Vassilievsky)

NAME AND AGENCY:
BUCHWALDT L, GOSSEN B and CHONGO G
Agriculture and Agri-Food Canada, Saskatoon Research Centre,
107 Science Place, Saskatoon, Saskatchewan S7N 0X2
Tel: (306) 956-2826 Fax: (306) 956-7247 Email: BuchwaldtL@em.agr.ca

TITLE: EFFECT OF FOLIAR FUNGICIDE APPLICATION FOR CONTROL OF DISEASES IN LENTIL, 1999.

MATERIALS: BRAVO 500, BRAVO ULTREX (50% and 82.5% w/w chlorothalonil) and QUADRIS (22.9% w/w azoxystrobin).

METHODS: In 1999, field trials were established in two commercial lentil crops cv. Laird located at Zealandia and Sovereign in SK. At early flowering, 1.2 m walkways were roto-tilled to establish plots in an area of each field with uniform plant stand and low weed pressure. The plot size was 2.4 x 6 m. There were twelve treatments arranged in a randomized complete block design with four replications. The treatments are shown in Table 1. The objectives were to compare rates and time of application of chlorothalonil and azoxystrobin; to compare a liquid (BRAVO 500) and a granular (BRAVO ULTREX) formulation of chlorothalonil; and to evaluate one versus two applications of each fungicide, and the best order in which to apply a protective (BRAVO 500) and a systemic (QUADRIS) fungicide. The fungicides were applied with a bicycle-sprayer fitted with Tee-Jet 8002 nozzles spaced 0.5 m apart, the spray solution was carried by CO_2 at 275 kPa, and the water volume was 200 L per hectare. Fungicide applications were made on July 6 and 20 at Zealandia and on July 14 and 29 at Sovereign. Disease ratings were made at the two spray dates, and again three to four weeks after the last fungicide application by assessing the amount of leaf and stem area affected by both anthracnose (*Colletotrichum truncatum*) and ascochyta blight (*Ascochyta lentis*) at five sites per plot using a Horsfall-Barrett scale (0-11). The ratings were converted to % infected plant area and averaged for each plot. The trial at Sovereign was desiccated with ROUNDUP and harvested on August 12, the other site at Zealandia was destroyed by farm equipment before harvest. Seed samples were dried, cleaned and weighed. Analysis of variance of disease and yield data was conducted using the General Linear Models Procedure of SAS, and Least Significant Difference ($LSD_{0.05}$) was used for comparison of means.

RESULTS: At the date of the first fungicide application, at early flower, leaf lesions and premature leaf drop caused by anthracnose were evident at both Sovereign (4%) and Zealandia (2%). At the second date of application, anthracnose had increased in the untreated control plots to 21% in Sovereign and 13% in Zealandia. By the third rating date, a high incidence of anthracnose and ascochyta was found at Sovereign (90%) and somewhat less at Zealandia (77%). Sclerotinia stem rot and botrytis grey mold occurred sporadically, but were not included in the disease ratings.

Comparison of treatments 2 and 3 showed that application of BRAVO at early flower increased yield more than application 10-14 days later. Treatment 5 showed that a split application of BRAVO was beneficial under high disease pressure, and better than a single application at the high rate in treatment 4. Treatments 6 to 9 showed that QUADRIS efficiently controled anthracnose and ascochyta, and increased yield, but that the high rate (175 g a.i. per ha) had an adverse effect on yield. Furthermore, two applications of QUADRIS at the low rate did not improve yield over a single application of 125 g a.i. per ha. There were no significant differences between the four treatments with two applications of either BRAVO (treatment 5), QUADRIS (treatment 9) or both fungicides (treatments 11 and 12).

CONCLUSIONS: According to a Fungicide Decision Support System currently under development at AAFC, Saskatoon, foliar fungicide application was warranted at both locations at early flower. Above normal rainfall in July and August resulted in high levels of anthracnose and ascochyta blight. A single low rate application of QUADRIS gave good control of both diseases, and improved lentil yield more than a single application of BRAVO 500. The time of application seems to be less critical with QUADRIS than with BRAVO which is an advantage, since it allows more time for field scouting and better disease diagnosis. However, QUADRIS had a adverse effect on yield when applied at the high rate (175 g a.i. per ha) at early flower. This was also seen in chickpea (see report in this issue) and needs to be studied further. QUADRIS is not yet registered for use in lentil.

Acknowledgment: Financial support from the Agri-Food Innovation Fund and Zeneca Agro is gratefully appreciated. Special thanks to Ken Bassendowski for technical assistance.

Table 1. Effect of BRAVO and QUADRIS on control of anthracnose and ascochyta blight in lentil at two locations in Saskatchewan, 1999.

	Fungicide treatment	Early flower	10-14 days later	Zealandia % infection[2] July 6 / July 20/ Aug. 19	Sovereign % infection[2] July 14 / July 29 / Aug. 19	Sovereign Yield kg/ha	Yield relative to the control
1	Control			2 / 13 / 77	4 / 21 / 90	593 e	100
2	BRAVO 500	1000 [1]		2 / 7 / 42	6 / 12 / 57	1131 bcd	190
3	BRAVO 500		1000	2 / 9 / 40	5 / 20 / 70	932 cde	157
4	BRAVO 500	1500		1 / 7 / 50	4 / 24 / 30	1261 abc	212
5	BRAVO 500	1000	1000	1 / 5 / 26	2 / 21 / 23	1443 ab	243
6	QUADRIS	125		1 / 6 / 59	4 / 18 / 44	1406 ab	237
7	QUADRIS		125	2 / 6 / 25	4 / 24 / 50	1401 ab	236
8	QUADRIS	175		1 / 5 / 62	4 / 26 / 66	828 de	139
9	QUADRIS	125	125	1 / 5 / 51	3 / 13 / 15	1584 a	267
10	BRAVO ULTREX	1000		1 / 7 / 37	4 / 31 / 57	1116 bcd	188
11	BRAVO + QUADRIS	1000	125	2 / 5 / 30	4 / 19 / 28	1287 abc	217
12	QUADRIS + BRAVO 500	125	1000	2 / 5 / 44	4 / 23 / 16	1427 ab	240
$LSD_{0.05}$				1 / 5 / 28	3 / 14 / 24	392	66

[1] Gram active ingredient per hectare.

[2] % leaf and stem area infected by anthracnose and ascochyta blight at the first and second date of fungicide application, and 3-4 weeks after the last application.

1999 PMR REPORT # 101 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Lentil, (*Lens culinaris* Medik.), cv. Laird
PEST: Ascochyta blight, *Ascochyta fabae* f.sp. *lentis* Gossen

NAME AND AGENCY:

CHANG K F, HOWARD R J and BRIANT M
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TURNBULL G D, HWANG S F and WANG H
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

TITLE: EVALUATION OF FOLIAR FUNGICIDES FOR THE CONTROL OF ASCOCHYTA BLIGHT OF LENTIL IN ALBERTA IN 1999

MATERIALS: BAS 500 (250 g/L EC), BRAVO ULTREX (chlorothalonil 82.5% WG), ABOUND (azoxystrobin 22.9% SC)

METHODS: An experimental plot was established in brown chernozemic clay-loam soil on 27 May, 1999 at Brooks, Alberta. Lentil cv. Laird was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 10 g per row. Nine foliar fungicide treatments were applied using a knapsack sprayer with a 8002 tee-jet nozzle at 250 kpa at early flowering (21 July) and at mid-flowering stage (4 August) using 100 L/ha water volume. A tenth treatment (BAS 500 at 0.15 kg ai/ha) was applied using a 25 L/ha water volume. Treatments included: BAS 500 applied once at 0.1, 0.15 and 0.3 kg ai/ha and twice at 0.1 and 0.15kg ai/ha; a second formulation of BAS 500 applied once at 0.15 kg ai/ha. BRAVO ULTREX was applied once and twice at 1.0 kg ai/ha and ABOUND applied once at 0.25 kg ai/ha. Ascochyta symptoms were negligible, so ratings were not presented. At maturity, on 15 Sept, 1999, plants from each plot were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: No significant differences were noted between spray treatments (Table 1). Application of BRAVO ULTREX or BAS 500 applied as the second formulation, as a double spray at the lower rate, or applied with a low water volume, resulted in significantly (*P*• 0.05) greater seed yield than the untreated control.

CONCLUSIONS: Levels of ascochyta foliar blight were not great enough to measure, but application of BAS 500 or BRAVO ULTREX at low levels improved overall plant health enough to result in a greater seed yield compared to the control.

Table 1. Effect of spraying BAS 500, BRAVO ULTREX and ABOUND on the seed yield of lentil cv. Laird at Brooks, Alberta in 1999.

Treatment	Rate kg ai/ha	Timing†	Yield g/6m²
Control	--	--	342.8 b*
BAS 500 01	0.1	EF	672.3 ab
BAS 500 01	0.15	EF	655.1 ab
BAS 500 00	0.15	EF	742.6 a
BAS 500 01§	0.15	EF	751.2 a
BAS 500 01	0.3	EF	534.3 ab
BAS 500 01	0.1	EF + MF	804.7 a
BAS 500 01	0.15	EF + MF	673.5 ab
BRAVO ULTREX	1	EF	797.6 a
BRAVO ULTREX	1	EF + MF	630.3 ab
ABOUND	0.25	EF	597.3 ab
ANOVA (P• 0.05)	–	–	s

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P• 0.05).

† Foliar fungicide applied at early flowering (EF) and at mid-flowering (MF) stages.

§ Applied using 25 L/ha water.

1999 PMR REPORT # 102 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Lentil (*Lens culinaris* L.), cvs. Eston and Laird
PEST: Root rot, *Rhizoctonia solani* Kühn

NAME AND AGENCY:

HWANG S F, TURNBULL G D and PAGE N T
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 Fax: (403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS TO CONTROL RHIZOCTONIA ROOT ROT OF LENTIL IN 1999

MATERIALS: APRON (metalaxyl, 317 g/L SN), VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU), U2727, LO 176

METHODS: Seed of lentil cvs. Eston and Laird was treated with VITAFLO 280, U2727 and LO 176 in a Hege II small batch seed treater at the rates given in Table 1. Experimental plots were established on 1 June at Vegreville, Alberta in black chernozemic sandy loam soil Plots were seeded in a split-plot randomized complete block design with four replications with lentil cultivars serving as main plots and fungicide seed treatment, along with *Rhizoctonia*-inoculated and non-inoculated controls, serving as subplots. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 4 cm deep at a rate of 6 and 10 g per row for Eston and Laird, respectively. *Rhizoctonia solani* was grown on a mixture of sterilized oat and rye kernels for 14 days, dried, ground and incorporated as inoculum at the rate of 30 mL/row at the time of seeding. Emerged seedlings were counted for each subplot three weeks after seeding . At maturity (27 September), plants from the middle 5 m of each plot were hand-harvested. Seeds were threshed and weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: VITAFLO 280 and U2727 produced significantly (*P*• 0.05) greater seedling emergence and seed yield than the inoculated control (Table 1). Seedling emergence for the LO 176 treatments was significantly (*P*• 0.05) lower than for the VITAFLO or the U2727 treatments. Both seedling emergence and seed yield were significantly (*P*• 0.05) greater for the VITAFLO compared to U2727. Seedling emergence was significantly (*P*• 0.05) greater for cv. Eston versus cv. Laird (Table 2).

CONCLUSIONS: Treatment of lentil seed with VITAFLO 280 or U2727 resulted in greater seedling emergence and seed yield than planting untreated seed. Treatment of seed with LO176 did not improve seedling emergence or seed yield over the inoculated control. Inoculation with *R. solani* resulted in significant disease pressure on lentil plants as evidenced by the high levels of emergence and seed yield of the noninoculated control.

Table 1. Effects of fungicidal seed treatments on seedling survival and seed yield of lentil cvs. Eston and Laird at Vegreville, Alberta in 1999.

Treatment	Rate (mL/kg seed)	Plants/6m	Seed yield (g/5 m^2)
VITAFLO+APRON +*R*†	3.3 + 5	52.3 b*	773.2 b
U2727+APRON+*R*	4.0 + 5	21.8 c	421.0 c
LO 176+APRON+*R*	1.25 + 5	12.5 d	311.0 cd
LO 176+APRON+*R*	2.5 + 5	14.6 d	306.1 cd
Control+*R*	--	9.6 d	191.4 d
Control	--	96.0 a	1100.5 a

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (*P*• 0.05).

† Denotes inoculation with *Rhizoctonia solani.*

Table 2. Comparison of seedling establishment and seed yield of lentil cvs. Eston and Laird at Vegreville, Alberta in 1999.

Cultivar	Plants/6m	Seed yield (g/5 m^2)
Eston	45.3 a*	640.8 a
Laird	23.6 b	393.5 b

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P• 0.05).

1999 PMR REPORT # 103 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Lentil, (*Lens culinaris* Medik.), cv. Eston
PEST: Root rot, *Pythium ultimum* Trow, *P. irregulare* Buisman

NAME AND AGENCY:
TURNBULL G D, HWANG S F and PAGE N T
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8623 Fax:(780) 632-8612 Email: george@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF PYTHIUM ROOT ROT OF LENTIL IN ALBERTA IN 1999

MATERIALS: MAXIM 480 (fludioxonil 480g/L FS), APRON XL (metalaxyl-M 369 g ai/L LS), APRON MAXX 240.5 (metalaxyl-M, 13.6%+fludioxonil, 9.11% MEC), DIVIDEND (difenoconazole, 32.8% FS), ADAGE (47.6% FS), VITAFLO 280 (carbathiin 14.9%+ thiram 13.2% SU), HELIX GREEN 156 FS (thiamethoxam, 156 g/L FS)

METHODS: Lentil cv. Eston was treated in a Hege small batch seed treater with APRON XL and APRON MAXX at 3.75 and 7.5 g ai/100 kg seed, MAXIM alone at 2.5 g ai/100 kg seed and combined with APRON XL at 3.75 and 7.5 g ai/100 kg seed, a combination of MAXIM, APRON, and DIVIDEND at 2.5, 7.5 and 12 g ai/100 kg seed, respectively, alone and combined with ADAGE at 25 and 50 g ai/100 kg seed as well as with HELIX GREEN at 200 g ai/100 kg seed. Seed was also treated with VITAFLO 280 at 88 g ai/100 kg seed. An experimental plot was established on 28 May, 1999 at Vegreville, Alberta, in black chernozemic sandy loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 4 cm deep at a rate of 6 g of seed per row. *Pythium ultimum* and *P. irregulare* were grown on sterilized oat grains for 14 days, then dried, ground, mixed and incorporated at the time of seeding at the rate of 40 mL/row (5 x 10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls. Emerged seedlings were counted 3 weeks after seeding. At maturity (24 September), 0.5 m was discarded from the end of each row and the remaining plants were hand-harvested, dried and threshed. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: The APRON-MAXIM-DIVIDEND combinations significantly (*P*• 0.05) improved seedling emergence over the inoculated control where ADAGE or HELIX GREEN were added. There were no significant differences between yield of treated and nontreated seed, or among seed treatments (Table 1).

CONCLUSIONS: Seedling emergence was improved by the APRON-MAXIM-DIVIDEND combinations where ADAGE or HELIX GREEN were added.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of lentil cv. Eston at Vegreville, Alberta in 1999.

Treatment	Rate (g ai/100 kg seed)	No. seedlings /6 m	Yield g /5m^2
Control	--	105.6 abc[*]	1614.4
Control+*Pythium* (*P*)	--	93.3 bc	1199.2
APRON XL+*P*	3.75	99.0 abc	1447.5
APRON XL+*P*	7.5	105.1 abc	1389.7
MAXIM+*P*	2.5	85.6 c	1179.4
APRON XL+ MAXIM+*P*	7.5 + 2.5	105.5 abc	1658.9
APRON MAXX+*P*	3.75	99.6 abc	1348.6
APRON MAXX+*P*	7.5	108.4 abc	1647.9
AMD[†]+*P*	7.5+2.5+12	109.5 abc	1413.6
AMD+ADAGE+*P*	7.5+2.5+12+25	114.3 ab	1645.8
AMD+ADAGE+*P*	7.5+2.5+12+50	110.9 ab	1557
AMD+HELIX GREEN+*P*	7.5+2.5+12+200	124.7 a	1426.6
VITAFLO 280 +*P*	88	100.4 abc	1390.1

[*] Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

[†] APRON XL+MAXIM+DIVIDEND

1999 PMR REPORT # 104 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Lentil, (*Lens culinaris* Medik.), cv. Eston
PEST: Root rot, *Fusarium avenaceum* (Fr.) Sacc.

NAME AND AGENCY:
TURNBULL G D, HWANG S F and WANG H
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8623 Fax:(780) 632-8612 Email: george@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre - South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: COMPARISON OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF FUSARIUM ROOT ROT OF LENTIL

MATERIALS: MAXIM 480 (fludioxonil 480g/L FS), APRON XL (metalaxyl-M 369 g ai/L LS), APRON MAXX 240.5 (metalaxyl-M, 13.6%+fludioxonil, 9.11% MEC), DIVIDEND (difenoconazole, 32.8% FS), ADAGE (47.6% FS), VITAFLO 280 (carbathiin 14.9%+ thiram 13.2% SU), HELIX GREEN 156 FS (thiamethoxam, 156 g/L FS)

METHODS: Lentil cv. Eston was treated in a Hege small batch seed treater with APRON XL and APRON MAXX at 3.75 and 7.5 g ai/100 kg seed, MAXIM alone at 2.5 g ai/ 100 kg seed and combined with APRON XL at 3.75 and 7.5 g ai/100 kg seed, a combination of MAXIM, APRON and DIVIDEND at 2.5, 7.5 and 12 g ai/100 kg seed, respectively, alone and combined with ADAGE at 25 and 50 g ai/100 kg seed as well as with HELIX GREEN at 200 g ai/100 kg seed. Seed was also treated with VITAFLO 280 at 88 g ai/100 kg seed. An experimental plot was established on 31 May, 1999 at Vegreville, Alberta, in black chernozemic sandy loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 4 cm deep at a rate of 6 g seeds per row. *F. avenaceum* was grown on sterilized oat grains for 14 days, then dried, ground, mixed and incorporated at the time of seeding at the rate of 30 mL/row (3 x 10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls. Emerged seedlings were counted 3 weeks after seeding. At maturity (24 September), plants were hand-harvested, dried and threshed. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Results are presented in Table 1. Seed treatments that significantly (*P*• 0.05) increased emergence over the inoculated control included MAXIM, APRON MAXX at the higher rate, and the APRON-MAXIM-DIVIDEND combination in conjunction with ADAGE at the higher rate or with HELIX GREEN. Seed yield was significantly (*P*• 0.05) improved over the inoculated control by the

APRON-MAXIM-DIVIDEND combination in conjunction with ADAGE at the higher rate or with HELIX GREEN.

CONCLUSIONS: Treatment with the APRON-MAXIM-DIVIDEND combination, in conjunction with ADAGE at the higher rate and with HELIX GREEN, restored seed yield to levels found in the noninoculated control. These two formulations and APRON MAXX at the higher rate significantly improved seedling emergence over the inoculated control.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of lentil cv. Eston at Vegreville, Alberta in 1999.

Treatment	Rate (g ai/100 kg seed)	No. seedlings /6m	Yield g /5m^2
Control	--	78.9 a[*]	897.5 a
Control+*Fusarium* (*F*)	--	14.6 e	339.1 c
APRON XL+*F*	3.75	22.0 cde	560.2 abc
APRON XL+*F*	7.5	15.7 de	464.7 c
MAXIM+*F*	2.5	30.7 c	609.4 abc
APRON XL+ MAXIM+*F*	7.5 + 2.5	26.3 cde	594.8 abc
APRON MAXX+*F*	3.75	27.0 cde	539.4 bc
APRON MAXX+*F*	7.5	29.5 cd	568.9 abc
AMD[†]+*F*	7.5+2.5+12	25.8 cde	603.6 abc
AMD+ADAGE+*F*	7.5+2.5+12+25	22.4 cde	496.6 c
AMD+ADAGE+*F*	7.5+2.5+12+50	34.3 c	898.5 a
AMD+HELIX GREEN+*F*	7.5+2.5+12+200	52.9 b	847.2 ab
VITAFLO 280 +*F*	88	22.5 cde	429.5 c

[*] Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

[†] APRON+MAXIM+DIVIDEND

1999 PMR REPORT # 105 SECTION L: DISEASES OF FIELD LEGUMES

CROP: Field pea (*Pisum sativum* L.) cvs. Carneval and Alfetta
PEST: Mycosphaerella blight (*Mycosphaerella pinodes* Berk. & Blox.)

NAME AND AGENCY:
BUCHWALDT L[1], GOSSEN B D[1], HWANG S F[2], KUTCHER R[3], CHONGO G [1]
[1] AAFC, SRC, 107 Science Place, Saskatoon, SK S7N 0X2
Tel. (306) 956-2826 Fax. -7247 Email: BuchwaldtL@em.agr.ca, GossenB@em.agr.ca
[2] Alberta Research Counsil, Bag 4000, Vegreville, AB T9C 1T4
Tel. (403) 632-8228 Fax. -8379
[3] AAFC, MRF, Box 1240, Melfort, SK S0E 1A0
Tel. (306) 752-227 ext. 232 Fax -4911

TITLE: EFFECT OF FOLIAR FUNGICIDE APPLICATION ON CONTROL OF MYCOSPHAERELLA BLIGHT IN PEA, 1999.

MATERIALS: BRAVO 500 and BRAVO ULTREX (50% w/w and 82.5% w/w chlorothalonil) and QUADRIS (22.9% w/w azoxystrobin).

METHODS: Foliar application of fungicides for control of mycosphaerella blight in field pea were established at Westlock and Mundare, AB, and at Star City and Prince Albert, SK. Plot size, equipment, and treatment dates for each location are described in Table 1. There were 12 fungicide treatments in a complete randomized block design with four replicates. The spray equipment was either a knapsack or bicycle sprayer fitted with Tee-jet 8002 nozzles. Water volume was 500L/ha in AB and 220L/ha in SK. The twelve treatments were as shown in Table 2. The objectives were to compare rates and time of application of chlorothalonil and azoxystrobin; to compare a liquid (BRAVO 500) and a granular (BRAVO ULTREX) formulation of chlorothalonil; to evaluate one versus two applications of each fungicide, and to test the best order in which to apply a protective fungicide (BRAVO 500) and a systemic fungicide (QUADRIS).

Foliar disease severity caused by mycosphaerella blight was rated prior to each fungicide application in order to determine a disease threshold for treatment. The disease was rated as percent infected leaf area at the bottom 1/3, middle 1/3 and top 1/3 of the pea canopy at five sites per plot, and an average for the three canopy levels were calculated for each plot. A third rating of mycosphaerella blight was made three to four weeks after the last fungicide application using the same procedure. The plots were direct combined and the seed dried, cleaned and weighed. Analysis of variance of disease and yield data was conducted using the General Linear Models Procedure of SAS, and Least Significant Difference ($LSD_{0.05}$) was used for comparison of means.

RESULTS AND CONCLUSIONS:
At Mundare and Westlock, both fungicide applications at early flower and 10-14 days later, were made at zero or trace levels of mycosphaerella blight. Three to four weeks after the last fungicide application between 20-50% of the bottom 1/3 of the canopy was infected at the trial Mundare, while less than 20% was affected at Westlock (data not shown). The disease did not spread to the middle or top of the

canopy at neither location. One treatment, the early low rate application of QUADRIS at Mundare, significantly increased yield, while the rest were not significantly different from the control (Table 2). This could be an artifact, since this treatment in combination with other fungicide treatments did not increase yield as would be expected. Furthermore, yield increase from fungicide application would not be expected at these low levels of mysocphaerella infection.

At Star City, there was about 1-2% mycosphaerella infection on the first date of application and 10% on the second date (data not shown). On August 4, the disease had increased to almost 100% at the bottom 1/3 of the pea canopy, 25-50% in the middle, and 1-20 % at the top (Table 2). Only small yield increases resulted from fungicide application; probably because both applications were made too early, when infections were still low. This is supported by the fact that a fungicide applied at mid flower (treatment 3 and 7) resulted in higher yields than at early flower (treatment 2 and 6), although these differences were not statistically different. At Prince Albert, there was 0.5-4% infection of mycosphaerella at the bottom 1/3 of the canopy on the first date of application and 15% on the second date (data not shown). On August 23, mycosphaerella blight had increased to almost 100% at the bottom 1/3 of the canopy, 30-80% in the middle, and 1-30% at the top (Table 2). Some of the BRAVO and QUADRIS treatments reduced the disease in the middle and top 1/3 of the canopy. At this high disease pressure, QUADRIS either by itself or in combination with BRAVO increased yield significantly above the untreated control (treatments 6, 7, 11 and 12). QUADRIS at 175 g a.i./ha applied at early flower did not adversely affect yield as it did in lentil and chickpea (see this issue), however, QUADRIS is not yet registered for use in field pea. There was no difference between the liquid formulation of chlorthalonil (BRAVO 500) and the granular formulation (BRAVO ULTREX), but neither significantly increased yield above the unsprayed control. There was a tendency that the systemic fungicide, azoxystrobin, followed by the protective fungicide, chlorothalonil, increased yield more than when applied in the reverse order, but yields were not statistically different (treatment 11 and 12). More field trials are necessary to determine whether the better yield response to fungicide treatment in the trial at Prince Albert was due to the susceptible cultivar Alfetta compared to Star City, where the less susceptible cultivar Carneval was grown. Earlier planting and flowering of the pea trial in Star City might also have had an effect.

Acknowledgment: Financial support from the Agri-Food Innovation Fund and Zeneca Agro is gratefully appreciated. Special thanks to Colleen Kirkham and George Turnbull for technical assistance.

Table 1. Details regarding fungicide evaluation in four pea trials, 1999.

	Mundare	Westlock	Star City	Prince Albert
Pea cultivar	Carneval	Carneval	Carneval	Alfetta
Plot size, meter	7.2 m^2	7.2 m^2	20 m^2	10.4m^2
Seeding date	36290	36289	36273	36304
1st fungicide application	July 16	36352	June 28	July 19
2nd fungicide application	36367	36366	36350	July 29
Harvest date	36397	36394	36401	36778

Table 2. Effect of BRAVO and QUADRIS on control of mycospharella blight of pea and seed yield at four locations in 1999.

Fungicide treatment	Early flower	10-14 days later	Mundare Yield Kg/ha	Westlock Yield Kg/ha	Star City		Prince Albert	
					% inf.[3] Aug. 4	Yield Kg/ha	% inf Aug. 23	Yield Kg/ha
1 Control			3100 b	4420 a	99/57/18	4546 ab	100/64/20	4162 c
2 BRAVO 500	1.0 [1]		3130 b	4440 a	85/42/7	4664 ab	97/67/21	4275 c
3 BRAVO 500		1	3460 ab	4040 ab	81/23/2	4839 ab	100/78/28	4561 abc
4 BRAVO 500	1.5		3260 ab	4110 ab	86/47/6	4691 ab	95/48/15	4923 abc
5 BRAVO 500	1.0	1.0	3180 ab	4317 ab	66/16/1	5019 a	90/45/8	4885 abc
6 QUADRIS	125 [2]		4170 a	4520 a	95/62/16	4279 b	92/49/17	5187 ab
7 QUADRIS		125	3290 ab	4030 ab	97/51/10	4719 ab	95/53/18	5194 ab
8 QUADRIS	175		3320 ab	4420 a	98/48/6	4823 ab	92/47/15	4961 abc
9 QUADRIS	125	125	3300 b	4350 ab	87/41/9	4706 ab	74/32/1	4961 abc
10 BRAVO ULTREX	1.0		3760 ab	3740 b	97/64/12	4772 ab	99/64/25	4416 bc
11 BRAVO +QUADRIS	1.0	125	2910 b	4250 ab	85/35/6	4602 ab	80/34/10	5185 ab
12 QUADRIS + BRAVO	125	1.0	3580 ab	4510 a	85/24/3	5017 a	85/37/3	5314 a
$LSD_{0.05}$			1000	680		612		884

[1] Kilogram active ingredient per hectare

[2] Gram active ingredient per hectare

[3] Percent leaf area infected with mycosphaerella blight at the bottom 1/3, the middle 1/3, and the top 1/3 of the canopy 3-4 weeks after the last fungicide application.

1999 PMR REPORT # 106 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Field pea, (*Pisum sativum* L.), cv. Carrera
PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.)

NAME AND AGENCY:
CHANG K F, HOWARD R J and BRIANT M A
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TURNBULL G D, HWANG S F and PAGE N T
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

TITLE: EVALUATION OF FOLIAR FUNGICIDES FOR THE CONTROL OF MYCOSPHAERELLA BLIGHT OF FIELD PEA IN ALBERTA IN 1999

MATERIALS: BAS 500 (250 g/L EC), BRAVO ULTREX (chlorothalonil 82.5% WG), ABOUND (azoxystrobin 22.9% SC)

METHODS: Experimental plots were established on 11 May, 1999 in black chernozemic sandy loam soil at Mundare, Alberta and on 27 May, 1999 in brown clay-loam soil at Brooks, Alberta. Field pea cv. Carrera was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 22 g per row. Nine foliar fungicide treatments were applied using a knapsack sprayer with a 8002 tee-jet nozzle at 250 kpa at early flowering (16 July and 21 July) and at mid-flowering stage (27 July and 4 August) using 100 L/ha water volume at Vegreville and Brooks, respectively. A tenth treatment (BAS 500 at 0.15 kg ai/ha) was applied using a 25 L/ha water volume. Treatments included: BAS 500 applied once at 0.1, 0.15 and 0.3 kg ai/ha and twice at 0.1 and 0.15kg ai/ha; a second formulation of BAS 500 applied once at 0.15 kg ai/ha. BRAVO ULTREX was applied once and twice at 1.0 kg ai/ha and ABOUND applied once at 0.25 kg ai/ha. On 6 and 26 August, 1999, ascochyta blight severity was rated at Vegreville and Brooks, respectively, on a 0-3 scale for the upper, middle and lower leaves: 0= healthy, 1= 1-25% of leaf area covered by lesions, 2=26-50% covered, and 3= > 50% of leaf area covered by lesions. Scores for upper, middle and lower leaves were added to produce a 0-9 scale for the whole plant. At maturity, on 26 August and 11 September, 1999, plants from each plot were harvested by small plot combine at Vegreville and Brooks, respectively. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: All fungicide treatments significantly (*P*• 0.05) reduced disease severity compared with the nontreated control at both sites (Table 1). No differences in disease severity were observed between treatments at Mundare, but the plots at Brooks which were sprayed twice with BRAVO ULTREX, the highest application rate of BAS 500, or two sprays of BAS 500, showed significantly lower levels of disease severity than the single spray of BAS 500 at the lowest rate, the single spray of BAS 500 at the lower water volume, and the single spray of BRAVO ULTREX. No differences between treatments were observed with respect to seed yield.

CONCLUSIONS: All fungicidal spray treatments suppressed mycosphaerella symptoms, but disease severity was generally very low at both sites since weather conditions were not conducive to spore development and dispersal. Double application of spray treatments and application at higher rates resulted in a greater degree of symtom suppression.

Table 1. Effect of spraying BAS 500 and BRAVO ULTREX on the severity of mycosphaerella blight and seed yield of field pea cv. Carneval at Brooks and Mundare, Alberta in 1999.

Treatment	Rate kg ai/ha	Timing§	Brooks		Mundare	
			Disease Severity †	Yield g/6m²	Disease Severity †	Yield g/6m²
Control	--	--	2.08 a*	2119	2.45 a	957.4
BAS 500 01	0.1	EF	1.18 b	2185.5	1.35 b	1074.4
BAS 500 01	0.15	EF	1.05 bc	2357.9	1.45 b	1081.2
BAS 500 00	0.15	EF	1.10 bc	2321.1	1.55 b	965.9
BAS 500 01§	0.15	EF	1.13 b	2588	1.35 b	1094.8
BAS 500 01	0.3	EF	0.63 d	2225.9	0.95 b	1328.3
BAS 500 01	0.1	EF + MF	0.63 d	2163.7	1.20 b	1483
BAS 500 01	0.15	EF + MF	0.58 d	2247.3	1.10 b	1110.5
BRAVO ULTREX	1	EF	1.18 b	2290.2	1.35 b	974.8
BRAVO ULTREX	1	EF + MF	0.78 cd	2275.9	1.60 b	1135.1
ABOUND	0.25	EF	1.03 bc	2495.8	1.45 b	1292.5
ANOVA (P• 0.05)	--	--	s	ns	s	ns

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P• 0.05).

§ Foliar fungicide applied at early flowering (EF) and at mid-flowering (MF) stages.

† Foliar disease rating scale: 0= healthy, 1= 1-25%, 2=26-50%, 3= > 50% of leaf area covered by lesions. Scores for lower, middle and upper leaves were added to produce a 0-9 scale.

‡ Applied using 25 L/ha water volume.

1999 PMR REPORT # 107 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Field pea (*Pisum sativum* L.), cv. Carrera
PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.)

NAME AND AGENCY:
HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax: (780) 632-8379 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 Fax: (403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF FOLIAR SPRAY FORMULATIONS FOR THE CONTROL OF MYCOSPHAERELLA BLIGHT OF FIELD PEA IN ALBERTA IN 1999

MATERIALS: TILT 250 (propiconazole, 250 g/L EC), STRATEGO 250 (propiconazole + CGA-279202, 125 + 125 g/L EC), FLINT 125 (CGA-279202, 125 g/L EC), ACTIGARD 50 (CGA-245704, 50% WG) and QUADRIS 250 (azoxystrobin, 250 g/L EC).

METHODS: Experimental plots were established on 10 May, 1999 at Westlock, Alberta, in black chernozemic loam soils. Field pea cv. Carrera was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 22 g per row. Foliar fungicide treatments (TILT 250 applied at 62.5 and 125 g a.i./ha, STRATEGO applied at 62.5 and 125 g ai/ha, STRATEGO + ACTIGARD applied at 125 and 10 g ai/ha, respectively, ACTIGARD applied at 10 g ai/ha, FLINT 125 applied at 62.5 g ai/ha and QUADRIS 250 applied at 250 g ai/ha) were applied on 13 July using a knapsack sprayer with a 8002 tee-jet nozzle at 250 kpa at early bloom using 1000 L/ha water volume. Water was applied to the nontreated control. Mycosphaerella blight severity was rated at 5 sites per plot on a 0-3 scale for the upper, middle and lower leaves (0=healthy, 1=1-25% of leaf area covered by lesions, 2=26-50 % covered, 3=greater than 50% of leaf area covered by lesions) on 10 August. The values for upper, middle and lower leaves were added for each site to produce a 0-9 scale. At maturity, on 23 August, 1999, plants from each plot were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Although disease occurred at very low levels, all fungicide treatments reduced disease severity on leaves (Table 1). Treatment with QUADRIS and STRATEGO + ACTIGARD resulted in lower ascochyta leaf spot ratings than treatment ACTIGARD or with TILT at the lower rate. No significant differences in seed yield occurred between treated and untreated plots, or among treatments.

CONCLUSIONS: All formulations tested reduced mycosphaerella blight severity compared with untreated plots. The QUADRIS and STRATEGO + ACTIGARD treatments suppressed mycosphaerella blight more effectively than ACTIGARD and TILT at the lower rate. Seed yield was unaffected by treatment.

Table 1. Effect of foliar spray treatments on the severity of mycosphaerella blight and seed yield of field pea cv. Carrera at Westlock in 1999.

Treatment	Rate (g a.i./ha)	Disease severity (0-9)[†]	Yield ($g/5m^2$)
Control	--	2.5 a[*]	1645.2
TILT 250 EC	62.5	1.9 b	1645.2
TILT 250 EC	125	1.7 bc	1772.5
STRATEGO 250 EC	62.5	1.7 bc	1605.8
STRATEGO 250 EC	125	1.7 bc	1704.8
STRATEGO + ACTIGARD	125 + 10	1.4 c	1757
ACTIGARD	10	1.9 b	1743.9
FLINT 125 EC	62.5	1.7 bc	1704.4
QUADRIS 250	250	1.5 c	1701.2
ANOVA (*P*• 0.05)		s	ns

[†] Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (*P*• 0.05).

[*] Foliar disease severity rating scale: 0=healthy, 1=1-25% of leaf area covered by lesions, 2=26-50 % covered, 3=greater than 50% of leaf area covered by lesions. The rating was repeated for lower, middle and upper leaves and the values were added to produce a rating between 0 and 9.

1999 PMR REPORT # 108 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Field pea (*Pisum sativum* L.), cv. Carrera
PEST: Powdery mildew, *Erysiphe pisi* Syd.

NAME AND AGENCY:
HWANG S F and TURNBULL G D
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax: (780) 632-8379 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 Fax: (403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF FOLIAR SPRAY FORMULATIONS FOR THE CONTROL OF POWDERY MILDEW OF FIELD PEA IN 1999

MATERIALS: TILT 250 (propiconazole, 250 g/L EC), STRATEGO 250 (propiconazole + CGA-279202, 125 + 125 g/L EC), FLINT 125 (CGA-279202, 125 g/L EC), ACTIGARD 50 (CGA-245704, 50% WG) and QUADRIS 250 (azoxystrobin, 250 g/L EC)

METHODS: Experimental plots were established on 9 June, 1999 at Mundare, Alberta, in black chernozemic loam soils. Field pea cv. Carrera was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 22 g per row. Foliar fungicide treatments (TILT 250 applied at 62.5 and 125 g ai/ha, STRATEGO applied at 62.5 and 125 g ai/ha, STRATEGO + ACTIGARD applied at 125 and 10 g ai/ha, respectively, ACTIGARD applied at 10 g ai/ha, FLINT 125 applied at 62.5 g ai/ha and QUADRIS 250 applied at 250 g ai/ha) were applied on 6 August using a knapsack sprayer with a 8002 tee-jet nozzle at 250 kpa at early bloom using 1000 L/ha water volume. Water was applied to the nontreated control. Powdery mildew severity was rated at four sites per plot on a 0-9 scale (Table 1).

Plants were rated on 27 August. At maturity, on 22 September, 1999, plants from each plot were hand-harvested. Plants were subsequently bagged, dried and threshed and seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: Data are presented in Table 2. All fungicide treatments, except ACTIGARD, had significantly lower disease severity than the untreated control. Treatment with TILT at the higher rate or with FLINT resulted in lower powdery mildew ratings than any other treatment, except STRATEGO at the higher rate. Seed yield was significantly higher for QUADRIS than for TILT at the higher rate or STRATEGO at the lower rate.

CONCLUSIONS: All formulations, except ACTIGARD, reduced powdery mildew disease severity compared with untreated plots. Plots treated with FLINT or TILT at the higher rate had lower disease severity than all other treatments except STRATEGO and TILT at the higher rates. Seed yield was greater for QUADRIS than for TILT at the higher rate or STRATEGO at the lower rate.

Table 1. Powdery mildew severity scale.

Disease Severity	% Infected Plants	% Infected Area
0	0	0
1	36528	trace
2	36654	36526
3	10-49	36588
4	50-99	36654
5	100	36822
6	100	25-49
7	100	50-74
8	100	75-99
9	100	100

Table 2. Effect of foliar spray treatments on the severity of powdery mildew and seed yield of field pea cv. Carrera at Mundare in 1999.

Treatment	Rate (g a.i./ha)	Disease severity (0-9)†	Yield (g/5m^2)
Control	--	6.2 a*	396.5 ab
TILT 250 EC	62.5	4.2 bc	420.3 ab
TILT 250 EC	125	3.3 d	379.7 b
STRATEGO 250 EC	62.5	4.7 b	366.3 b
STRATEGO 250 EC	125	3.9 cd	446.2 ab
STRATEGO + ACTIGARD	125 + 10	4.1 bc	403.2 ab
ACTIGARD	10	5.6 a	414.4 ab
FLINT 125 EC	62.5	3.1 d	395.3 ab
QUADRIS 250	250	4.5 bc	525.8 a

† Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (*P*• 0.05).

* Disease severity rating scale explained in the text.

1999 PMR REPORT # 109 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Field pea (*Pisum sativum* L.), cvs. Carneval and Highlight
PEST: Root rot, *Rhizoctonia solani* Kühn

NAME AND AGENCY:
HWANG S F, TURNBULL G D and WANG H
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax: (780) 632-8612 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel: (403) 362-1334 Fax: (403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS TO CONTROL RHIZOCTONIA ROOT ROT OF FIELD PEA IN 1999

MATERIALS: APRON (metalaxyl, 317 g/L SN), VITAFLO 280 (carbathiin 14.9% + thiram 13.2% SU), U2727, LO 176

METHODS: Seed of pea cvs. Carneval and Highlight was treated with VITAFLO 280, U2727 and LO 176 in a Hege II small batch seed treater at the rates given in Table 1. Experimental plots were established on 1 June at Vegreville, Alberta in black chernozemic sandy loam soil. Plots were seeded in a split-plot randomized complete block design with four replications. Pea cultivars served as main plots and fungicide seed treatment, along with *Rhizoctonia*-inoculated and non-inoculated controls, served as subplots. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 5 cm deep at a rate of 20 g per row. *Rhizoctonia solani* was grown on a mixture of sterilized oat and rye kernels for 14 days, dried, ground and incorporated as inoculum at the rate of 30 mL/row at the time of seeding. Emerged seedlings were counted for each subplot three weeks after seeding. At maturity (15 September), plants from the middle 5 m of each plot were hand-harvested. Seeds were threshed and weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: All seed treatments produced significantly (*P*• 0.05) greater seedling emergence and seed yield than the inoculated control (Table 1). Seedling emergence for the LO 176 treatments was significantly (*P*• 0.05) lower than for the VITAFLO or the U2727 treatments, and was lower for this treatment at the high versus low rate. Seed yield was significantly (*P*• 0.05) greater for the VITAFLO treatment than for the U2727 treatment, but neither treatment differed significantly from the LO 176 treatments. Highlight had significantly (*P*• 0.05) greater seedling establishment and seed yield than Carneval (Table 2).

CONCLUSIONS: Although all seed treatments improved seedling emergence and seed yield, the high rate of application of LO 176 did not improve emergence or seed yield, and this fungicide showed a less positive effect on seedling emergence and seed yield than VITAFLO.

Table 1. Effects of fungicidal seed treatments on seedling survival and seed yield of pea cvs. Carneval and Highlight at Vegreville, Alberta in 1999.

Treatment	Rate (mL/kg seed)	Plants/6m	Seed yield ($g/5\ m^2$)
VITAFLO+APRON +*R*†	3.3 + 5	96.7 a*	1385.9 ab
U2727+APRON+*R*	4.0 + 5	93.6 ab	1193.8 c
LO 176+APRON+*R*	1.25 + 5	80.1 c	1306.6 bc
LO 176+APRON+*R*	2.5 + 5	73.3 d	1276.8 bc
Control+*R*	--	53.4 e	916.6 d
Control	--	90.6 b	1507.1 a

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (*P*• 0.05).

† Denotes inoculation with *Rhizoctonia solani.*

Table 2. Comparison of seedling establishment and seed yield of field pea cvs. Carneval and Highlight at Vegreville, Alberta in 1999.

Cultivar	Plants/6m	Seed yield ($g/5\ m^2$)
Carneval	63.3 b	1190.7 b
Highlight	99.3 a	1338.3 a

* Means within a column followed by the same letter are not significantly different using Duncan's New Multiple Range Test (P• 0.05).

1999 PMR REPORT # 110 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Field pea, (*Pisum sativum* L.), cvs. Carneval and Carrera
PEST: Root rot, *Pythium ultimum* Trow, *P. irregulare* Buisman

NAME AND AGENCY:
HWANG S F, TURNBULL G D, WANG H and PAGE N T
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF CAPTAN AND APRON FORMULATIONS FOR CONTROL OF PYTHIUM ROOT ROT OF FIELD PEA IN 1999

MATERIALS: CAPTAN FL (captan 30% SU), CF CLEAR, APRON FL (metalaxyl 317 g/L SN)

METHODS: Field pea cv. Carneval was treated in a Hege small batch seed treater with CAPTAN FL at 280 and 560 mL/kg/100 kg seed both alone, in combination with APRON, and combined with APRON and CF CLEAR seed coating. APRON was also applied alone. An experimental plot was established on 20 May, 1998 at Vegreville, Alberta, in black chernozemic sandy loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 20 cm apart. Seeds were planted 5 cm deep at a rate of 22 g per row. *Pythium ultimum* and *P. irregulare* were grown on sterilized oat grains for 14 days, ground, dried, then mixed and incorporated at the time of seeding at the rate of 40 mL/row (5 x 10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls Emerged seedlings were counted 4 weeks after seeding. Roots were evaluated for root rot and nodulation on 10 plants/subplot on 17 August. Root rot was rated on a 0-4 scale where: 0=healthy, 1=slight discoloration, 2=moderate lesions covering <25% of root, 3=large lesions covering 25-50% of root, 4=extensive root dieback, lesions covering more than 50% of root. Nodulation was rated on a 0-3 scale where: 0=no nodulation, 1=small, sparse nodules, 2=larger, more profuse nodules, 3=nodules in large clumps. At maturity (26 August), plants were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: All seed treatments significantly increased emergence over both inoculated and noninoculated controls (*P*• 0.05)(Table 1). CAPTAN + APRON at the lower rate with CF CLEAR improved emergence over CAPTAN alone, but not over any of the other treatments. All treatments had a lower root rot rating than the inoculated control, and were not significantly different from the noninoculated control (*P*• 0.05). Nodulation was similar for all treatments and controls. Seed yield did not differ significantly among seed treatments, but was significantly higher than the inoculated control for the APRON treatment alone, for APRON + CAPTAN at the lower rate, and for APRON + CAPTAN + CF CLEAR at the higher rate.

CONCLUSIONS: All fungicide treatments improved seedling emergence over both inoculated and noninoculated controls. Seedling emergence was similar among seed treatments, except where CAPTAN + APRON at the lower rate with CF CLEAR was compared with CAPTAN alone. All treatments decreased root rot intensity, but none affected nodulation. Mean seed yield was higher than the control for all treatments, but only significantly higher for APRON alone, APRON + CAPTAN at the lower rate, and APRON + CAPTAN + CF CLEAR at the higher rate.

Table 1. Effect of CAPTAN seed treatments on number of emerged seedlings, root rot, nodulation and seed yield of field pea cv. Carrera at Vegreville, Alberta in 1999.

Treatment	Rate (mL/100 kg seed)	No. seedlings /6 m	Root rot severity (0-4)[y]	Nodulation (0-3)[z]	Yield $g/5m^2$
Control	--	66.6 c	0.11 b	0.99	1524.5 ab
Control+*Pythium* (*P*)	--	60.1 d	0.37 a	0.84	1234.7 b
CAPTAN (C)+*P*	280	76.0 ab	0.13 b	0.91	1606.3 ab
C+*P*	560	72.0 b	0.10 b	1	1599.3 ab
APRON (A)+*P*	110	76.9 ab	0.12 b	0.88	1727.7 a
C+A+*P*	280+110	75.5 ab	0.05 b	0.9	1687.7 a
C+A+CF CLEAR+*P*	280+110+60	77.7 a	0.12 b	0.97	1642.3 ab
C+A+*P*	560+220	77.2 ab	0.11 b	0.7	1642.2 ab
C+A+CF CLEAR+*P*	560+220+60	76.4 ab	0.12 b	0.79	1674.1 a
ANOVA (*P*• 0.05)		s	s	ns	s

[*] Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

[y] Root rot rating: 0=healthy, 1=slight discoloration, 2=moderate lesions covering <25% of root, 3=large lesions covering 25-50% of root, 4=extensive root dieback, lesions covering more than 50% of root.

[z] Rating of nodulation: 0=no nodulation, 1=small, sparse nodules, 2=larger, more profuse nodules, 3=nodules in large clumps.

1999 PMR REPORT # 111 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Pea, (*Pisum sativum* L.) cv. Majoret
PEST: Root rot, Pythium ultimum Trow, *P. irregulare* Buisman

NAME AND AGENCY:

HWANG S F, TURNBULL G D and PAGE N T
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF PYTHIUM ROOT ROT OF PEA IN ALBERTA IN 1999

MATERIALS: MAXIM 480 (fludioxonil 480g/L FS), APRON XL (metalaxyl-M 369 g ai/L LS), APRON MAXX 240.5 (metalaxyl-M, 13.6%+fludioxonil, 9.11% MEC), DIVIDEND (difenoconazole, 32.8% FS), ADAGE (47.6% FS), VITAFLO 280 (carbathiin 14.9%, thiram 13.2% SU), HELIX GREEN 156 FS (thiamethoxam, 156 g/L FS)

METHODS: Pea cv. Majoret was treated in a Hege small batch seed treater with APRON XL and APRON MAXX at 3.75 and 7.5 g ai/100 kg seed, MAXIM alone at 2.5 g ai/100 kg seed and combined with APRON XL at 3.75 and 7.5 g ai/100 kg seed, a combination of MAXIM, APRON and DIVIDEND at 2.5, 7.5 and 12 g ai/100 kg seed, respectively, alone and combined with ADAGE at 25 and 50 g ai/100 kg seed, as well as with HELIX GREEN at 200 g ai/100 kg seed. Seed was also treated with VITAFLO 280 at 88 g ai/100 kg seed. An experimental plot was established on 19 May, 1999 at Vegreville, Alberta, in black chemozemic sandy loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 4 cm deep at a rate of 22 g of seed per row. *Pythium ultimum* and *P. irregulare* were grown on sterilized oat grains for 14 days, ground, dried, then mixed and incorporated at the time of seeding at the rate of 40 mL/row (5 x 10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls. Emerged seedlings were counted 4 weeks after seeding. At maturity (26 August), plants were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: The MAXIM-APRON-DIVIDEND combinations, where added to ADAGE or HELIX GREEN, significantly (*P*• 0.05) improved seedling emergence over the inoculated control (Table 1). Both APRON MAXX formulations, APRON XL at the lower rate, and APRON XL + MAXIM also improved seedling emergence over the inoculated control. Treatment with APRON MAXX at the lower rate or the

MAXIM-APRON-DIVIDEND combination with HELIX GREEN resulted in significantly (*P*• 0.05) greater emergence than treatment with the MAXIM-APRON-DIVIDEND combination alone. There were no significant differences between yield of treated and nontreated seed, or among seed treatments.

CONCLUSIONS: Seedling emergence was improved by the MAXIM-APRON-DIVIDEND combinations where ADAGE or HELIX GREEN were added, by APRON MAXX, and by APRON XL at the lower rate and in combination with MAXIM.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of pea cv. Majoret at Vegreville, Alberta in 1999.

Treatment	Rate (g ai/100 kg seed)	No. seedlings /6 m	Yield g /$5m^2$
Control	--	62.5 ab[*]	1503
Control+*Pythium* (*P*)	--	55.5 c	1269.4
APRON XL+*P*	3.75	62.5 ab	1515.1
APRON XL+*P*	7.5	59.8 abc	1570.4
MAXIM+*P*	2.5	59.9 abc	1241.3
APRON XL+ MAXIM+*P*	7.5 + 2.5	63.0 ab	1330.9
APRON MAXX+*P*	3.75	64.1 a	1362.3
APRON MAXX+*P*	7.5	63.6 ab	1311.3
AMD[†]+*P*	7.5+2.5+12	59.0 bc	1363.2
AMD+ADAGE+*P*	7.5+2.5+12+25	62.7 ab	1540.3
AMD+ADAGE+*P*	7.5+2.5+12+50	62.5 ab	1635.7
AMD+HELIX GREEN+*P*	7.5+2.5+12+200	64.1 a	1444.5
VITAFLO 280 +*P*	88	59.6 abc	1357.9

[*] Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

[†] APRON XL+MAXIM+DIVIDEND

1999 PMR REPORT # 112 **SECTION L: DISEASES OF FIELD LEGUMES**
ICAR: 61009653

CROP: Pea, (*Pisum sativum* L). cv. Majoret
PEST: Root rot, *Fusarium avenaceum* (Fr.) Sacc.

NAME AND AGENCY:

HWANG S F, TURNBULL G D and WANG H
Alberta Research Council
Bag 4000, Vegreville, Alberta T9C 1T4
Tel: (780) 632-8228 Fax:(780) 632-8612 Email: hwang@arc.ab.ca

CHANG K F and HOWARD R J
Crop Diversification Centre South
SS#4, Brooks, Alberta T1R 1E6
Tel:(403) 362-1334 Fax:(403) 362-1326 Email: changk@agric.gov.ab.ca

TITLE: **EVALUATION OF FUNGICIDAL SEED TREATMENTS FOR THE CONTROL OF FUSARIUM ROOT ROT OF PEA IN ALBERTA IN 1999**

MATERIALS: MAXIM 480 (fludioxonil 480g/L FS), APRON XL (metalaxyl-M 369 g ai/L LS), APRON MAXX 240.5 (metalaxyl-M, 13.6%+fludioxonil, 9.11% MEC), DIVIDEND (difenoconazole, 32.8% FS), ADAGE (47.6% FS), VITAFLO 280 (carbathiin 14.9%, thiram 13.2% SU), HELIX GREEN 156 FS (thiamethoxam, 156 g/L FS)

METHODS: Pea cv. Majoret was treated in a Hege small batch seed treater with APRON XL and APRON MAXX at 3.75 and 7.5 g ai/100 kg seed, MAXIM alone at 2.5 g ai/100 kg seed and combined with APRON XL at 3.75 and 7.5 g ai/100 kg seed, a combination of MAXIM, APRON and DIVIDEND at 2.5, 7.5 and 12 g ai/100 kg seed, respectively, alone and combined with ADAGE at 25 and 50 g ai/100 kg seed, as well as with HELIX GREEN at 200 g ai/100 kg seed. Seed was also treated with VITAFLO 280 at 88 g ai/100 kg seed. An experimental plot was established on 20 May, 1999 at Vegreville, Alberta, in black chernozemic sandy loam soil. The plot was seeded in a randomized complete block design with four replications. Each subplot consisted of four, 6 m rows of plants spaced 25 cm apart. Seeds were planted 4 cm deep at a rate of 22 g of seed per row. *Fusarium avenaceum* was grown on sterilized oat grains for 14 days, dried, ground, and incorporated at the time of seeding at the rate of 30 mL/row (3 x 10^2 CFU/mL). Nontreated seeds were planted as inoculated and noninoculated controls. Emerged seedlings were counted 4 weeks after seeding. At maturity (26 August), plants were harvested by small plot combine. Seeds were weighed to determine yields. Data were subjected to analysis of variance using a General Linear Models Procedure (SAS) and, where appropriate, Duncan's New Multiple Range Test was performed for means comparison.

RESULTS: All treatments, except APRON XL, significantly (*P*• 0.05) improved seedling emergence over the inoculated control (Table 1). Both APRON MAXX formulations, APRON XL + MAXIM and the MAXIM-APRON-DIVIDEND combination, where used with ADAGE at the lower rate or with HELIX GREEN, significantly (*P*• 0.05) improved seedling emergence over VITAFLO 280. There were no significant differences between yield of treated and nontreated seed, or among seed treatments.

CONCLUSIONS: Seedling emergence was improved by all fungicides in the trial, except APRON XL. Treatment with VITAFLO 280 resulted in more seedling losses than treatment with APRON MAXX formulations, APRON XL + MAXIM and the MAXIM-APRON-DIVIDEND combination where used with ADAGE at the lower rate or with HELIX GREEN.

Table 1. Effect of seed treatments on number of emerged seedlings and seed yield of pea cv. Majoret at Vegreville, Alberta in 1999.

Treatment	Rate (g ai/100 kg seed)	No. seedlings /6 m	Yield g /5m^2
Control	--	58.7 a[*]	780.2
Control+*Fusarium* (*F*)	--	27.6 d	434.6
APRON XL+*F*	3.75	26.1 d	505.8
APRON XL+*F*	7.5	27.7 d	404.2
MAXIM+*F*	2.5	52.8 bc	506.3
APRON XL+ MAXIM+*F*	7.5 + 2.5	55.8 ab	715.5
APRON MAXX+*F*	3.75	53.2 b	719.8
APRON MAXX+*F*	7.5	54.3 ab	610.1
AMD[†]+*F*	7.5+2.5+12	52.7 bc	583.7
AMD+ADAGE+*F*	7.5+2.5+12+25	55.6 ab	620.7
AMD+ADAGE+*F*	7.5+2.5+12+50	52.9 bc	770
AMD+HELIX GREEN+*F*	7.5+2.5+12+200	53.7 b	600.7
VITAFLO 280 +*F*	88	48.6 c	410.1

[*] Means within a column followed by the same letter are not significantly different for each experimental variable using Duncan's New Multiple Range Test (*P*• 0.05).

[†] APRON XL+MAXIM+DIVIDEND

END OF SECTION L (Reports # 90-112, Pages 239 - 304).

SECTION M: POTATOES/ POMMES DE TERRE

REPORTS /RAPPORTS # 113-116

PAGES: 305 - 313

EDITOR **Ms. Agnes M. Murphy**

Agriculture and Agri-Food Canada
Fredericton Research Centre
850 Lincoln Road, P.O. Box 20280
Fredericton, New Brunswick E3B 4Z7

Email: murphya@em.agr.ca
Tel: (506) 452-3260
Fax: (506) 452-3316

1999 PMR REPORT # 113 **SECTION M: POTATOES - Diseases.**
STUDY DATA BASE: 303-1251-9601

CROP: Potato (*Solanum tuberosum* L.) cv. Russet Burbank
PEST: Black scurf (*Rhizoctonia solani* Kühn)
Silver scurf (*Helminthosporium solani* Dur. and Mont.)
Dry rot (*Fusarium* spp.).

NAME AND AGENCY

ERRAMPALLI D, ARSENAULT W, and MACISAAC KA
Agriculture and Agri-Food Canada, Crops and Livestock Research Centre
P.O. Box 1210, Charlottetown, PE, Canada, C1A 7M8
Tel: (902)-566-6846 Fax (902) 566-6821 E-mail: errampallid@em.agr.ca

TITLE: **EFFICACY OF SEED PIECE TREATMENT FUNGICIDES, MAXIM (FLUDIOXONIL), DIVIDEND/MAXIM (DIFENACONAZOLE/FLUDIOXONIL) AND EASOUT (THIOPHANATE-METHYL 10% PSPT) ON BLACK SCURF, SILVER SCURF AND DRY ROT OF POTATOES, 1998-1999.**

MATERIALS: MAXIM®(fludioxonil 0.33%, 0.5% PSPT; Novartis); DIVIDEND/MAXIM® (difenaconazole/fludioxonil 0.66%, 1.00% PSPT; Novartis) and EASOUT (Thiophanate-methyl 10% PSPT, Novartis). The rate of application for each of the fungicides is presented in Table 1.

METHODS: A trial was conducted at the Crops and Livestock Research Centre's Research Farm in Harrington, PEI, on potato cv. Russet Burbank in 1998. The average initial black scurf incidence (percent tuber area covered with sclerotia) on seed tubers at planting was 2.7 %. After cutting and prior to fungicide treatments, the seed pieces were dip inoculated with *Fusarium* spp (*F. solani, F. sambucinum*) spore suspensions at a concentration of 1 x 10^4 CFU/ml for 3 min and air dried. Seed pieces, treated with the appropriate fungicide in a plastic bag for a minimum of 2 minutes, and controls without fungicide, were planted within two hours of the treatment. Each treatment (30 seed pieces/plot) was replicated 4 times in a randomized complete block design. Fertilizers, herbicides, insecticides and late blight fungicides were applied as and when required, at standard recommended rates (Publ. 1300A, Potato crop: variety, weed and pest control guide 1998 for the Atlantic Provinces). Emergence and stem counts were recorded on June 19, 1998, and the plots were harvested on October 9, 1998. Tuber yields were determined at harvest. Fifty progeny tubers from eachreplicate were washed with water and rated for the incidence of black scurf *(R. solani)*, silver scurf *(H. solani)*, and dry rot (*Fusarium* spp.) after harvest (4 November, 1998), and two and a half months after storage (20 January, 1999). Statistical analyses of the data were conducted using Genstat 5.0 (Lawes Agricultural Trust, Rothamsted Experimental Station, UK).

RESULTS: Similar emergence rates and the number of stems/plant in all seed piece treatments suggests that the fungicides were not phytotoxic to potato plants. Results on the effect of fungicides on black scurf, silver scurf, dry rot and common scab are presented (Table 1). During 1998, the high incidence (57.5 to 76.3%) of scab in all the treatments and the untreated control check has interfered with the ratings of all diseases and yield data and therefore, caution must be taken in interpreting the results presented in Table 1. In this experiment, cv. Russet Burbank, reported to be resistant to scab (Publ. 1300A, Potato crop: variety, weed and pest control guide 1998 for the Atlantic Provinces), was found highly susceptible to scab. Efficacy of MAXIM as potato seed piece treatment was tested on cv. Russet Burbank, in three different locations on PEI and the high levels of scab was found only at Harrington location. Planting of potatoes in disease nursery which had continuous potatoes for 4 consecutive years may have resulted in >57.5% of scab incidence at Harrington. A significantly high incidence of scab in fungicide treated plots and the untreated check suggests that the fungicides were not effective against scab. With the exception of DIVIDEND/MAXIM 0.66%, all 4 treatments had significantly higher scab than untreated check and these results must be confirmed by testing efficacy of MAXIM 0.5% PSPT against common scab under high disease pressure. MAXIM 0.5% PSPT treated plots had significantly lower black scurf than other fungicide treatments and untreated check. Low incidence of dry rot (1.4 to 2.9 %) and silver scurf (1.4 to 1.6%) was present in treatments and untreated check. With the exception of MAXIM 0.33% PSPT and DIVIDEND/MAXIM 0.33% PSPT, all other treatments showed significantly higher marketable yields than the untreated check. There was no significant increase of diseases after harvest. This trial will be repeated in 1999 field season.

CONCLUSIONS: During 1998, MAXIM 0.5% PSPT treatment reduced black scurf and increased common scab and tuber yield.

Table 1. Effect of MAXIM and DIVIDEND/ MAXIM seed piece treatment fungicides on the incidence of black scurf (*Rhizoctonia solani*), silver scurf (*Helminthosporium solani*), dry rot (*Fusarium* spp.) and common scab (*Streptomyces scabies*), and yield at harvest, in a field experiment at Harrington, PEI in 1998[a].

Treatment	Rate of product (ai)/ kg seed	% Tuber area covered with[b]				Marketable yield (t/ha)[c]
		Black scurf	Common scab	Dry rot	Silver scurf	
Untreated check	-----	8.7	60.2	1.4	1	20.7
MAXIM® 0.33% PSPT	0.0166 g	7.1	73.9	1.8	1	19.6
MAXIM® 0.5% PSPT	0.025 g	5.1	69.7	2.6	1	28.1
DIVIDEND/MAXIM® 0.66% PSPT	0.0166 g + 0.0166 g	9.6	65.3	1.7	1	23.6
DIVIDEND/MAXIM® 1.0% PSPT	0.025 g + 0.025 g	8.3	70.5	2.9	1	27.7
EASEOUT 10% PSPT	0.50 g	9.5	76.6	2.2	1	26.3
LSD for comparing means (P=0.05)		1.7	5.9	0.7	0.1	5.3
ANOVA for Treatment P• 0.05		s	s	s	ns	s

[a] Tubers were rated for diseases on 4 November, 1998.

[b] Symptoms were masked by scab lesions; Values are means of four replications/treatment, 50 tubers/replication were rated for each of the diseases.

[c] Canada No. 1 Marketable Yield (55 - 85 mm)

1999 REPORT # 114 **SECTION M: POTATOES - Diseases.**
STUDY DATA BASE: 303-1251-9601

CROP: Potato (*Solanum tuberosum* L.) cv. Yukon Gold
PEST: Silver scurf (*Helminthosporium solani* Dur. and Mont.)
Black scurf (*Rhizoctonia solani* Kühn)

NAME AND AGENCY:
ERRAMPALLI D, ARSENAULT W, and MACISAAC KA
Agriculture and Agri-Food Canada, Crops and Livestock Research Centre
P.O. Box 1210, Charlottetown, PE, Canada, C1A 7M8
Tel: (902)-566-6846 Fax (902) 566-6821 E-mail: errampallid@em.agr.ca

TITLE: EVALUATION OF EFFECTIVENESS OF SEED PIECE TREATMENT, DITHANE M-45 DUST, FOR CONTROL OF SILVER SCURF (*HELMINTHOSPORIUM SOLANI*) ON POTATO IN PEI, 1998-1999.

MATERIALS: DITHANE M-45 (8% and 24%; Rohm and Haas). The rate of application for each of the concentrations of the fungicide is presented in the Table 1.

METHODS: A trial was conducted at the Crops and Livestock Research Centre's Research Farm in Harrington, PEI, with potato cv. Yukon Gold, seed with high levels of silver scurf (35.0 %). After cutting, seed pieces were treated by shaking the seed pieces and the appropriate fungicide treatment in a plastic bag for a minimum of 2 minutes. Seed was planted within two hours of the treatment. The untreated check received no fungicide. The trial was planted on 26 May, 1998 in rows 90 cm apart with seed spacing of 30 cm. Plots were 3.6 m long and 3 row wide for a total of 36 seed pieces per plot. Each treatment was replicated 4 times in a randomized complete block design. Fertilizers, herbicides, insecticide and late blight fungicides were applied at recommended rates (Publ. 1300A, Potato crop: variety, weed and pest control guide 1998 for the Atlantic Provinces). Plant emergence counts and stem counts were taken on 19 June, 1998. The plots were harvested on 9 October, 1998. Tuber yields were determined at harvest. Thirty to 50 progeny tubers from each replicate were washed with water and rated for the incidence of silver scurf *(H. solani*), and black scurf *(R. solani*), after harvest (4 November, 1998), and 3.6 months after storage (23 February,1999). Statistical analyses of the data were conducted using Genstat 5.0(Lawes Agricultural Trust, Rothamsted Experimental Station, UK).

RESULTS: Similar rates of emergence and number of stems/plant between untreated check and the treatments show that DITHANE M-45 was not phytotoxic to potatoes. Disease incidences are summarized in Table 1. Silver scurf was not present at harvest but disease was seen after storage. There was significantly less silver scurf in DITHANE M-45 treated plots (19.1 %) than in the control (27.1 %). High incidence of silver scurf on seed tubers at planting (35.0 %) may have resulted in the high incidence of silver scurf in progeny tubers. A high incidence of Rhizoctonia black scurf was also observed in both the treatments and in the untreated check. Black scurf also increased in storage. Yield data shows no significant difference in yield between untreated check and DITHANE M-45 treated plots. This trial will be repeated in 1999 field season using seed with low silver scurf incidence.

CONCLUSIONS: DITHANE M-45, 8 % and DITHANE M-45, 24 % significantly reduced silver scurf, but were not effective against black scurf. These results show that cv. Yukon Gold is susceptible to both silver scurf and black scurf. There was no significant difference in yield between the untreated check and the two treatments.

Table 1. Effect of different fungicides on silver scurf (*Helminthosporium solani*) and black scurf (*Rhizoctonia solani*)at harvest (4 November, 1998) and 3.6 months after storage (23 February, 1999), and on marketable yield.

Treatment	Rate of product (ai)/100 kg seed	% tuber area covered with[a]				Marketable yield (t/ha)[b]
		Silver scurf		Black scurf		
		4 Nov, 1998	23 Feb, 1999	4 Nov, 1998	23 Feb, 1999	4 Nov, 1998
Untreated check	-----	0	27.1	18.1	23.1	29.4
DITHANE M- 45, 8 %	1.0 kg	0	21.8	17.2	21.3	23.9
DITHANE M- 45, 24 %	1.0 kg	0	19.1	16	16.9	26.3
LSD for comparing means ($P=0.05$)		0	4.4	2.2	2.6	22.9
ANOVA for Treatment $P= 0.05$		ns	s	ns	s	ns

[a] Based on 4 replications per treatment, 50 tubers/replication were rated for each of the diseases.

[b] Canada No. 1 Marketable Yield (55 - 85 mm).

1999 PMR REPORT # 115 SECTION M: POTATOES -Diseases

CROP: Potato (*Solanum tuberosum* L.), cv. Shepody
PEST: Late blight, *Phytophthora infestans* (Mont.) de Bary

NAME AND AGENCY:
VAN DEN BERG, C.G.J. and BEKKERING, C.
ICMS, Inc., Suite 313, 151-32500 South Fraser Way, Abbotsford, BC. V2T 4W1
Tel: (604)853-7322 Fax: (604)853-7322 Email: vandenbg@icms-inc.com

TITLE: EFFICACY OF FOLIAR FUNGICIDES FOR CONTROL OF LATE BLIGHT ON POTATOES AT ABBOTSFORD, BC, IN 1999

MATERIALS: BRAVO 500 (500 g/L chlorothalonil), DITHANE DF Rainshield NT (75% mancozeb), Li700 (80% propionic acid), MANKOCIDE (15% mancozeb + 45% copper hydroxide; 35% copper equivalent), POLYRAM DF (80% metiram), RH141,457B (8% RH117,281 + 67% mancozeb)

METHODS: Cut pieces of Shepody potatoes were planted using a 2-row planter on May 26 in a silt loam. Experimental plots were 7 m long and 1.8 m wide (2 rows), separated by 1 m bare ground. The experiment was conducted as a RCBD with 4 replications. Weeds were controlled with 4.5 L/ha LINURON on 6/3/99. Fertilizer (14-0-45) was broadcast at 550 kg/ha on July 5. Plots were hilled on July 9. Foliar fungicides were applied in a volume of 275 L/ha using a hand-held sprayer with flat-fan nozzles beginning June 30 and ending August 24. Plots were irrigated on July 13, August 2 and August 28 with a retractable overhead gun. Late blight was rated using key no. 3.1.2 (Can. Plant Dis. Surv. 51:60). When infection was less than 1%, the number of infected stems was counted. The incidence was converted to a percentage between 0.1 and 0.9%. Plots were desiccated with 4.0 L/ha REGLONE on September 3 and harvested on September 20. Tuber yield was determined at harvest. After harvest, tubers were graded into undersize (diameter less than 5.4 cm) and main grade tubers. Tubers with visible signs of rot were removed and weighed. All analyses are based on untransformed data. Means were separated using Duncan's multiple range test.

RESULTS: First late blight symptoms were noted on July 9. The isolate was classified as US8, which is an A2 strain. Symptoms were initially limited to stem lesions and dead growing tips. July was drier than normal, and late blight remained at low levels. August had above normal precipitation and late blight progressed very rapidly. Following the rainy period of August 15-16, the untreated control was dead and treatments started to break down. On August 11, all treatments had very low levels of late blight severity (Table 1). The untreated control had extensive leaf and stem symptoms. On August 25, all treatments were affected by late blight, while the untreated control was dead. The lowest disease severity was observed for spray schedules with DITHANE and RH141,457B.

A protective spray schedule increased the gross tuber yield between 89 and 260%. Tuber yield was highest for treatments with DITHANE or RH141,457B. All treatments reduced the percentage undersized potatoes in comparison to the untreated control. The percentage undersized potatoes was smallest for treatments with RH141,457B. Treatments with RH141,457B had a lower percentage tuber rot than the treatments with DITHANE, BRAVO, or POLYRAM. The percentage of rotted tubers was low in the untreated control at harvest. A large number of tubers was infected in the untreated plots at the end of August. These tubers may have rotted too much to be harvested at the end of September.

CONCLUSIONS: All treatments reduced foliar infection and increased tuber yield. DITHANE and RH141,457B provided most effective control of late blight.

Table 1. Rating of late blight on potato leaves, gross tuber yield, percentage undersized potatoes, percentage rotting potatoes and application dates for each treatment.

Treatments	Rate	Disease rating		Gross yield	Undersized potatoes	Rotting potatoes	Application dates
		36382	36396				
	kg/ha L/ha	%	%	t/ha	%	%	
Untreated	-	62.5a	100a	12.0d	20.4a	3.4	-
DITHANE	2.25	0.2b	20de	36.2ab	6.2bc	22.7a	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
RH141,457B	1.7	0.2b	31d	34.1ab	6.0bc	9.6cde	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
RH141,457B	2.25	0.2b	15	39.4a	4.9c	7.4de	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
RH141,457B RH141,457B RH141,457B	1.70 2.00 2.25	0.2b	15	40.4a	5.1c	8.4de	6/30, 7/8, 7/15, 7/20 7/27, 8/3, 8/10, 8/17, 8/24
RH141,457B DITHANE	2.25 2.25	0.3b	15	43.5a	4.2c	8.3de	6/30, 7/15, 8/10 7/8, 7/20, 7/27, 8/3, 8/17, 8/24
MANKOCIDE	2	0.5b	85b	23.3c	8.5b	12.5b-e	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
MANKOCIDE	4	0.5b	75b	22.7c	8.6b	14.2a-d	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
POLYRAM + Li700	2.25 0.35	0.4b	50c	28.2bc	7.1bc	19.1ab	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
BRAVO	2.4	0.4b	50c	27.8bc	5.9bc	18.0abc	6/30, 7/8, 7/15, 7/20, 7/27, 8/3, 8/10, 8/17, 8/24
LSD(0.05)		6.6	12	8.8	3	8.4	

1999 PMR REPORT # 116 **SECTION M: POTATOES -Diseases**

CROP: Potato (*Solanum tuberosum* L.), cv. Shepody
PEST: Late blight, *Phytophthora infestans* (Mont.) de Bary

NAME AND AGENCY:
VAN DEN BERG, C.G.J.
ICMS, Inc.,
Suite 313, 151-32500 South Fraser Way, Abbotsford, BC. V2T 4W1
Tel: (604)853-7322 Fax: (604)853-7322 Email: vandenbg@icms-inc.com

TITLE: EFFICACY OF FLUAZINAM AND IKF-916 AGAINST LATE BLIGHT OF POTATOES AT ABBOTSFORD, BC, IN 1999

MATERIALS: BRAVO 500 (500 g/L chlorothalonil), IKF-916 (40% IKF-916), FLUAZINAM (50% fluazinam)

METHODS: Cut pieces of Shepody potatoes were planted using a 2-row planter on May 26 in a silt loam. Experimental plots were 7 m long and 1.8 m wide (2 rows), separated by 1 m bare ground. The experiment was conducted as a RCBD with 4 replications. Weeds were controlled with 4.5 L/ha LINURON on 6/3/99. Fertilizer (14-0-45) was broadcast at 550 kg/ha on July 5. Plots were hilled on July 9. Foliar fungicides were applied in a volume of 275 L/ha using a hand-held sprayer with flat-fan nozzles beginning June 30 and ending August 24. Plots were irrigated on July 13, August 2 and August 28 with a retractable overhead gun. Late blight was rated using key no. 3.1.2 (Can. Plant Dis. Surv. 51:60). When infection was less than 1%, the number of infected stems was counted. The incidence was converted to a percentage between 0.1 and 0.9%. Plots were desiccated with 4.0 L/ha REGLONE on September 3 and harvested on September 20. Tuber yield was determined at harvest. After harvest, tubers were graded into undersize (diameter less than 5.4 cm) and main grade tubers. Tubers with visible signs of rot were removed and weighed. All analyses are based on untransformed data. Means were separated using Duncan's multiple range test.

RESULTS: First late blight symptoms were noted on July 9, caused by an US8 strain. Symptoms were initially limited to stem lesions and dead growing tips. July was drier than normal, and late blight remained at low levels. August had above normal precipitation and late blight progressed very rapidly. On August 11, all treatments had very low levels of late blight severity (Table 1). The untreated control had extensive leaf and stem symptoms. On August 25, the untreated control was dead. Disease severity was higher for the BRAVO treatment than for the treatments with FLUAZINAM and IKF-916. Disease severity was similar for the treatments of IKF-916 with weekly or extended intervals between applications.

A protective spray schedule increased the gross tuber yield between 148 and 207%. Tuber yield was highest for the treatment with 0.2 L/ha IKF-916. All treatments reduced the percentage undersized potatoes in comparison to the untreated control. Treatments with FLUAZINAM and IKF-916 had a lower percentage tuber rot than the treatment with BRAVO. The percentage of rotted tubers was low in the untreated control at harvest. Many infected tubers may have rotted too much to be harvested, since a large number of tubers was infected in the untreated plots at the end of August.

CONCLUSIONS: FLUAZINAM and IKF-916 provided very effective control of late blight. Extended spray schedules of IKF-916 provided the same level of control as weekly spray schedules.

Table 1. Rating of late blight on potato leaves, gross tuber yield, percentage undersized potatoes, percentage rotting potatoes and application dates for each treatment.

		Disease rating					
Treatments (spray interval)	Rate	36383	36396	Gross yield	Undersized potatoes	Rotting potatoes	Application dates
	L/ha	%	%	t/ha	%	%	
Untreated	-	50.0a	100a	14.3c	17.3a	2.4bc	-
BRAVO (weekly)	2.4	1.4b	9b	37.3b	4.2b	10.3a	7/3, 7/9, 7/15, 7/21, 7/27, 8/3, 8/10, 8/17, 8/23
IKF-916 (weekly)	0.1	0.4b	2c	37.2b	4.0b	5.1a	7/3, 7/9, 7/15, 7/21, 7/27, 8/3, 8/10, 8/17, 8/23
IKF-916 (weekly)	0.15	0.2b	2c	39.3ab	4.0b	1.0c	7/3, 7/9, 7/15, 7/21, 7/27, 8/3, 8/10, 8/17, 8/23
IKF-916 (weekly)	0.2	0.2b	1c	43.9a	3.9b	0.7c	7/3, 7/9, 7/15, 7/21, 7/27, 8/3, 8/10, 8/17, 8/23
IKF-916 (weekly)	0.25	0.4b	2c	35.6b	5.4b	1.2c	7/3, 7/9, 7/15, 7/21, 7/27, 8/3, 8/10, 8/17, 8/23
FLUAZINAM (weekly)	0.4	0.4b	3c	40.2ab	4.1b	2.7bc	7/3, 7/9, 7/15, 7/21, 7/27, 8/3, 8/10, 8/17, 8/23
IKF-916 (extended)	0.2	0.4b	1c	39.4ab	5.3b	2.2bc	7/3, 7/12, 7/21, 8/3, 8/13, 8/23
IKF-916 (extended)	0.25	0.4b	1c	41.2ab	3.5b	1.0c	7/3, 7/12, 7/21, 8/3, 8/13, 8/23
LSD(0.05)		10	5	5.7	4.6	3.4	

END OF SECTION M (Reports # 113-116, Pages 305-313).

SECTION N: CEREAL, FORAGE AND OILSEED CROPS - Diseases — CÉRÉALES, CULTURES FOURRAGÈRES ET OLÉAGINEUX

REPORTS /RAPPORTS # 117-127

PAGES: 314-350

EDITORS **Dr. Richard A. Martin**

Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetown, P.E.I. C1A 7M8

Email: martinra@em.agr.ca
Tel: (902) 566-6851
Fax:(902) 566-6821

N Also)
SMUT - Diseases

Dr. Jim G. Menzies

Agriculture and Agri-Food Canada
Winnipeg Research Centre
195 Dafoe Road
Winnipeg, Manitoba R3T 2M9

Email: jmenzies@em.agr.ca
Tel: (204) 983-5714
Fax: (204) 983-4604

1999 PMR REPORT # 117 **SECTION N: DISEASES OF CEREALS, FORAGE CROPS and OILSEEDS**
STUDY DATA BASE: 375-1231-9614:

CROP: Alfalfa (*Medicago sativa)*
PEST: Blossom blight (*Botrytis cinerea* and *Sclerotinia sclerotiorum*)

NAME AND AGENCY:
GOSSEN B D, BASSENDOWSKI K A, and WONG B
Agriculture and Agri-Food Canada, Saskatoon Research Centre
107 Science Place, Saskatoon, Saskatchewan S7N 0X2
Tel: (306) 956-7259 Fax: (306) 956-7247 EM: GossenB@EM.Agr.ca

TITLE: EFFECT OF FUNGICIDE APPLICATION ON BLOSSOM BLIGHT AND SEED YIELD OF ALFALFA IN SASKATCHEWAN IN 1999

MATERIALS: BENLATE (benomyl, 50% WP); BRAVO 500 (chlorothalonil, 50% F); DITHANE (mancozeb, 75% DG), QUADRIS (azoxystrobin, 250 g/L)

METHODS: The efficacy of fungicides in reducing alfalfa blossom blight infection caused by *Botrytis cinerea* and *Sclerotinia sclerotiorum* was evaluated in commercial seed fields at MacDowall, Rosthern, Langham and St. Brieux, SK in 1999. Three fungicides, BENLATE (0.93 kg a.i. ha^{-1}), BRAVO 500 (1.5 L a.i. ha^{-1}), and DITHANE (1.6 kg a.i. ha^{-1}), were applied to the crop at early bloom (mid July), late bloom (late July), and early plus late bloom stage. A fourth fungicide, QUADRIS (125 g a.i. ha-1), was applied only at early bloom. Each fungicide was applied in 200 L/ha spray volume using a truck-mounted sprayer with Tee-Jet 8002 nozzles at 275 kPa. Fungicide treatments were compared with an untreated control. A randomized complete block design with four replications was used at each site, and each plot was 6 x 12 m. Mature florets (8 per plot) were collected from the controls prior to the first spray application, and from each plot at 6-10 days after each spray application. The flowers were plated onto a semi-selective medium without surface sterilization and incubated at room temperature and day length. The number of florets infected with *S. sclerotiorum* and *B. cinerea* were assessed after 6 d of incubation and expressed as a percentage. Seed harvest ($30m^2$) was taken at all sites in October. Infection incidence and yield were assessed using analysis of variance; Duncan's Multiple Range Test was used for comparison of means.

RESULTS: *Sclerotinia sclerotiorum* was the dominant pathogen of alfalfa flowers at all four sites. Levels of *B. cinerea* were very low throughout the sampling period. Prior to fungicide application at early bloom, pathogen incidence was a 28% *S. sclerotiorum* and 3% *B. cinerea* at MacDowall, 18% *S. sclerotiorum* and 0% *B. cinerea* at Rosthern, 23% *S. sclerotiorum* and 5% *B.cinerea* at Langham, and 40% *S. sclerotiorum* and 5% *B. cinerea* at St. Brieux. At Rating 1 (July 21-23), the incidence of *S. sclerotiorum* in the control had risen substantially at MacDowall, but pathogen incidence at the other sites stayed relatively constant (Table 1). BENLATE reduced the incidence of *S. sclerotiorum* at 1 site.

At Rating 2 (July 29-30), pathogen incidence had declined at 3 of 4 sites. The exception was St. Brieux. None of the fungicides reduced the incidence of *S. sclerotiorum*, but incidence tended to be lower in Early + Late treatments with BENLATE and BRAVO (Table 1).

Two applications of BENLATE increased seed yield at MacDowall and St. Brieux, but overall yield was so low at St. Brieux that fungicide application would not have been cost-effective (Table 2).

CONCLUSION: At MacDowall, early application of BENLATE reduced the incidence of *S. sclerotiorum* in alfalfa flowers (Table 1), but two applications were required to increase seed yield (Table 2). Fungicide application had no consistent effect at the other sites. However, the impact of a single application of QUADRIS was very similar to one application of BENLATE, so further testing is warranted. Infection incidence in Langham was low and yields were excellent in the control. Infection incidence was also low at Rosthern, but low numbers of leafcutter bees contributed to low yields. Yield was so low at St. Brieux that no reliable conclusion on the impact of fungicide application is possible.

ACKNOWLEDGEMENT: Thanks to AFIF for financial assistance and to Zeneca for fungicides.

Table 1. Impact of timing and frequency of fungicide application on incidence (%) of *Botrytis cinerea* (*Bc*) and *Sclerotinia sclerotiorum* (*Ss*) in four alfalfa seed production fields in Saskatchewan, 1999.

Timing and Fungicide	MacDowall		Rosthern		Langham		St. Brieux		Mean	
	Bc	*Ss*	*Bc*	*Ss*	*Bc*	*Ss*	*Bc*	*Ss*	*Bc*	*Ss*
Early bloom				Rating 1 (July 21-23)						
BENLATE	0 a†	21 c	2 a	31 a	6 ab	17 ab	2 a	28 a	3	24
BRAVO	5 a	55 a	5 a	35 a	2 b	14 ab	3 a	27 a	4	33
DITHANE	3 a	49 ab	0 a	16 a	5 ab	28 a	6 a	24 a	4	29
QUADRIS	0 a	32 bc	7 a	22 a	13 a	6 b	3 a	25 a	6	21
Control	4 a	50 ab	4 a	29 a	1 b	21 ab	3 a	31 a	3	33
Early bloom only				Rating 2 (July 29-30)						
BENLATE	0 b	10 a	19 a	16 a	10 a	10 a	3 ab	47 a	8	21
BRAVO	0 b	13 a	19 a	16 a	10 a	16 a	13 abc	31 a	11	19
DITHANE	3 ab	25 a	19 a	19 a	16 a	10 a	16 bc	32 a	14	22
QUADRIS	0 b	22 a	22 a	16 a	16 a	19 a	3 ab	38 a	10	24
Late bloom only										
BENLATE	0 b	13 a	22 a	13 a	25 a	13 a	19 c	32 a	17	18
BRAVO	7 a	16 a	7 a	22 a	16 a	16 a	0 a	35 a	8	22
DITHANE	0 b	28 a	7 a	10 a	3 a	22 a	13 abc	41 a	6	25
Early + Late bloom										
BENLATE	0 b	13 a	13 a	16 a	7 a	7 a	0 a	22 a	5	15
BRAVO	0 b	13 a	25 a	16 a	13 a	7 a	3 ab	22 a	10	15
DITHANE	0 b	13 a	19 a	19 a	7 a	28 a	13 abc	32 a	5	23
Control	3 ab	22 a	19 a	25 a	10 a	16 a	13 abc	50 a	11	28

† Means in a column followed by the same letter did not differ based on DMRT at P • 0.05.

Table 2. Impact of timing and frequency of fungicide application on seed yield (kg/ha) in four commercial alfalfa seed production fields in Saskatchewan, 1999 (n = 4).

Fungicide	Timing	MacDowall	Rosthern	Langham	St. Brieux	Mean
BENLATE	Early bloom	164 bc[†]	115 a	436 ab	66 b	195
	Late bloom	194 b	119 a	471 ab	73 ab	214
	Early + Late	246 a	109 a	497 a	97 a	237
BRAVO	Early bloom	146 bc	129 a	439 ab	79 ab	198
	Late bloom	138 bc	88 a	407 b	80 ab	178
	Early + Late	193 b	103 a	458 ab	69 ab	205
DITHANE	Early bloom	131 c	97 a	453 ab	62 b	186
	Late bloom	153 bc	82 a	408 b	75 ab	180
	Early + Late	149 bc	103 a	441 ab	70 ab	191
QUADRIS	Early bloom	147 bc	115 a	455 ab	69 ab	197
	Control	141 bc	87 a	439 ab	67 b	184

[†] Means in a column followed by the same letter did not differ based on DMRT at *P* • 0.05.

1999 PMR REPORT # 118 **SECTION N: DISEASES OF CEREALS, FORAGE CROPS and OILSEEDS**
STUDY DATA BASE: 375-1231-9614

CROP: Alfalfa (*Medicago sativa)*
PEST: Blossom blight (*Botrytis cinerea* and *Sclerotinia sclerotiorum*)

NAME AND AGENCY:
GOSSEN B D, BASSENDOWSKI K A, and WONG B
Agriculture and Agri-Food Canada, Saskatoon Research Centre
107 Science Place, Saskatoon, Saskatchewan S7N 0X2
Tel: (306) 956-7259 Fax: (306) 956-7247 EM: GossenB@EM.Agr.ca

TITLE: IMPACT OF SLOPE ON BLOSSOM BLIGHT MANAGEMENT AND SEED YIELD OF ALFALFA IN SASKATCHEWAN, 1998 -1999.

MATERIALS: BENLATE (benomyl, 50% WP)

METHODS: The impact of BENLATE (0.93 kg a.i. ha^{-1}) on flower infection by *Botrytis cinerea* and *Sclerotinia sclerotiorum* was evaluated across a slope gradient in commercial alfalfa seed fields at MacDowall and Rosthern, SK in 1998 and 1999. A single application of BENLATE was made at mid-to-late bloom in 1998 in 200 L/ha spray volume using a truck-mounted sprayer with Tee-Jet 8002 nozzles at 275 kPa. In 1999, two applications were made, one at early bloom (mid July) and the other at late bloom (late July). At each location, BENLATE was applied in two strips, which ran from top to bottom of the slope, and compared with two untreated control strips. The strips were about 52m long at MacDowall and 63m at Rosthern. In 1999, the leaf area index of the alfalfa stand was measured at 2 points adjacent to each sampling site using a plant canopy analyzer (LAI-2000, Li-Cor Inc., Lincoln, Nebraska).

Mature florets (8 per site) were sampled at sites along the slope (4 sites in 1998, 5 in 1999). Samples were taken prior to the first spray application (control strips only) and from all strips at 6-10 days after each spray application. The flowers were plated onto a semi-selective medium without surface sterilization and incubated at room temperature and daylength. The number of florets infected with *S. sclerotiorum* and *B. cinerea* were assessed after 6 d of incubation and expressed as a percentage. Seed harvest (11 or 15m^2) was taken in September or October each year. Analysis of variance was used to assess infection incidence and yield, and correlation analysis was conducted where appropriate.

RESULTS AND CONCLUSIONS: In 1998, the incidence of both pathogens was very low (Table 1) due to hot, dry weather throughout the flowering period. Neither pathogen was detected in samples from Rosthern. Yields were very low at this site due to low numbers of leafcutting bees and there was no clear association between position on slope and seed yield. At MacDowall, there was no association between position on slope and infection. Application of BENLATE had a small impact on the incidence of *S. sclerotiorum.* Seed yield was highly variable (Table 2); yield in the BENLATE-treated strips was 43% higher than the control, but the difference was not statistically significant.

In 1999, *S. sclerotiorum* was the dominant pathogen at both sites (Table 1). Prior to the first fungicide application in 1999, pathogen incidence was 13% *S. sclerotiorum* and 21% *B. cinerea* at MacDowall, and 8% *S. sclerotiorum* and 8% *B. cinerea* at Rosthern. In the assessments on July 21-22, application of BENLATE had a small impact on the incidence of *B. cinerea* at MacDowall. No differences between the treatments was observed at Rosthern at either date. There was no clear association between position on slope and infection incidence at either site (Table 1), or with leaf area index or seed yield at Rosthern (Table 2). At MacDowall, plant canopy density increased and yield decreased from the top to the bottom of the slope gradient. As in 1998, yields were highly variable; an 80% increase in yield associated with BENLATE application was not significant in a general analysis of variance. The impact of BENLATE was generally greater in the mid to bottom portions of the slope.

In both years and at both sites, pathogen incidence were very low and yields were highly variable. However, the data from MacDowall indicate that there may be an association between position on slope and response to BENLATE.

ACKNOWLEDGEMENT: We thank the AgriFood Innovation Fund for partial funding of the project.

Table 1. Incidence (%) of *Botrytis cinerea* (*Bc*) and *Sclerotinia sclerotiorum* (*Ss*) along a slope gradient in commercial alfalfa seed production fields in Saskatchewan, 1998 - 1999.

		MacDowall				Rosthern			
	Position	Control		BENLATE		Control		BENLATE	
Date	on slope	*Bc*	*Ss*	*Bc*	*Ss*	*Bc*	*Ss*	*Bc*	*Ss*
					1998				
July 30	crest	8	0	10	5	0	0	0	0
	upper	17	25	10	0	0	0	0	0
	lower	0	17	0	0	0	0	0	0
	bottom	8	0	5	0	0	0	0	0
Mean		8	10	6	1*	0	0	0	0
					1999				
July 21-22	crest	18	19	0	19	0	31	0	25
	upper	13	13	0	25	13	19	6	19
	mid	0	38	0	38	0	25	6	19
	lower	6	50	0	19	13	25	0	19
	bottom	6	38	6	38	0	38	6	13
Mean		9	31	1*	28	5	28	4	19
July 29	crest	0	0	6	25	13	25	31	31
	upper	6	19	6	13	25	19	31	19
	mid	0	25	0	22	38	13	25	31
	lower	0	38	13	22	13	13	38	13
	bottom	13	44	6	25	19	13	38	13
Mean		4	25	6	21	21	16	33	21

* Pathogen incidence lower than the control, based on DMRT at *P* • 0.05.

Table 2. Leaf area index (LAI) and seed yield (kg/ha) response to BENLATE fungicide application along a slope gradient in commercial alfalfa seed production fields in Saskatchewan, 1998 - 1999.

Position on slope	MacDowall			Rosthern		
	LAI	Control	BENLATE	LAI	Control	BENLATE
			1998			
crest	nd	352	257	nd	50	47
upper	nd	298	451	nd	67	60
middle	nd	165	313	nd	74	55
bottom	nd	56	226	nd	47	54
Mean	nd	218 a†	312 a	nd	60 a	54 a
			1999			
crest	1.2	100	126	nd	119	164
upper	1.7	nd	nd	3.1	102	129
mid	2.2	63	141	2.8	177	148
lower	3.1	nd	nd	3.2	281	188
bottom	6.2	14	50	3.6	242	215
Mean		59 a	106 a		184 a	169 a

[1] nd = not done.

† Means in a row and location followed by the same letter did not differ based on DMRT at *P* • 0.05.

1999 PMR REPORT # 119 SECTION N: DISEASES OF CEREALS, FORAGE CROPS AND OILSEEDS
STUDY DATA BASE: 385-1212-9808

CROP: Barley (*Hordeum vulgare* L.) cv Harrington
PEST: Scald (*Rhynchosporium secalis*)
Net blotch (*Pyrenophora teres*)

NAME AND AGENCY:
ORR DD[1], TURKINGTON TK[1] and KUTCHER R[2]
Agriculture and Agri-Food Canada
[1] Lacombe Research Centre, 6000 C & E Trail, Lacombe, AB T4L 1W1
Tel. (403) 782-8133 Fax (403) 782-6120 E-mail: orrdd@em.agr.ca
[2] Melfort Research Farm, PO Box 1240, Melfort, Saskatchewan S0E 1A0

TITLE: IMPACT OF TILT TIMING ON DISEASE MANAGEMENT IN HARRINGTON BARLEY, LACOMBE, ALBERTA AND MELFORT, SASKATCHEWAN, 1999

MATERIALS: TILT (25% propiconazole EC).

METHODS: At Lacombe, Harrington barley was seeded into worked fallow on May 20 in a RCBD with 4 replications. Plots were 4 rows, 5 m long with 2 rows of a non-host (wheat) between plots, all with 23 cm row spacing. Scald *(Rhynchosporium secalis*) infested straw and a 10^5 spore suspension/mL of *R. secalis* were applied to the plots on June 17 and June 21, respectively. TILT was applied in 200 L/ha water at the rates and times as noted in Table 1. The full rate of TILT was applied at 125 g ai/ha and the half rate (½ TILT) at 62.5 g ai/ha. The flag leaf application was done at Zadoks growth stage (GS) 37 on July 9 and the heading application at GS 65 on July 26. At GS 83, 20 flag and 20 flag-1 leaves were collected from each plot and rated for % leaf area diseased (PLAD) for scald, net blotch (*Pyrenophora teres*) and other leaf diseases. At maturity the entire plot was harvested, dried and yield parameters taken. Percent thins were determined by placing 100 g of seed on a 2.4 mm screen, shaking for 1 minute on a Ro-Tap seed shaker (W.S. Tyler, Inc., Gastonia, NC, USA) and weighing the grain that passed through the screen.

At Melfort, Harrington barley was seeded May 15 into zero till barley stubble in a 4 replicate RCBD. Plots were 2 m x 10 m long with 17.5 cm row spacing. TILT was applied at the rates and times as noted in Table 2. The full rate of TILT was applied at 125 g ai/ha and the half rate (½ TILT) at 62.5 g ai/ha. GS 31 occurred on June 25, GS 37 on July 2, GS 47 on July 9 and GS 65 on July 14. On July 14 and August 3, 25 plants were pulled from each plot and rated using the 0-11 McFadden scale. In addition on August 3, the flag, flag-1 and flag-2 leaves were rated for PLAD using the Horsfall-Barratt scale. This data was converted to the grade formula before data analysis. At maturity a strip 1.25 x 10 m was harvested, dried and yield parameters taken.

RESULTS: The results are presented in the tables below. At Lacombe (Table 1) all TILT treatments differed significantly from Untreated for flag leaf scald, flag leaf other, flag-1 leaf scald, flag-1 leaf net, kg/ha, 1000 kernel weight, bushel weight and % thins. There were no significant differences for flag-1 leaf other and only TILT GS 37 and ½ TILT GS 37 & 65 differed from Untreated for flag leaf net. At Melfort (Table 2), where disease came in later in the season, TILT applied at GS 37 had significantly less disease than Untreated for the McFadden rating on July 14. For the flag leaf rated August 3 and % thins, no treatments were significantly different compared to Untreated. For the flag-1 and flag-2, TILT GS 37, TILT GS 65 and ½ TILT GS 47 & 65 had significantly less disease than Untreated. For the August 3 McFadden score, only TILT GS 37 and TILT GS 65 had less disease than Untreated. TILT GS 31, TILT GS 47 and ½ TILT GS 47 did not differ signficantly from Untreated for any data parameter analysed. There were no significant differences for yield, 1000 kernel weight or bushel weight, however, the highest yield was recorded for ½ TILT GS 47 & 65 and the application of TILT tended to increase 1000 kernel weight.

CONCLUSIONS: The timing of TILT application appeared to be more critical at Melfort than at Lacombe. This may be related to the differences in disease spectra, weather conditions and when the diseases become more apparent.

Table 1a. Disease ratings for TILT timing applications from Lacombe, AB*.

Chemical	Scald Flag PLAD	Net Flag PLAD	Other Flag PLAD	Scald Flag-1 PLAD	Net Flag-1 PLAD	Other Flag-1 PLAD
Untreated	26.2 a	8.1 a	5.5 a	36.1 a	15.6 a	9.9
TILT - GS 37	2.8 b	5.0 b	3.1 b	6.6 b	10.8 b	4.9
½ TILT - GS 37	5.1 b	6.8 ab	3.1 b	7.8 b	11.2 b	4.1
½ TILT - GS 37 & 65	2.5 b	2.6 c	2.0 b	4.9 b	5.5 c	2.6

Table 1b. Yield parameters for TILT timing applications from Lacombe, AB*.

Chemical	Yield kg/ha	1000 Kernel Wt g	Bushel Wt kg/hl	Thins %
Untreated	4092 c	33.5 b	57.1 b	46.8 a
TILT - GS 37	5692 ab	37.5 a	61.5 a	24.9 b
½ TILT - GS 37	5400 b	37.9 a	60.4 a	29.4 b
½ TILT - GS 37 & 65	5939 a	39.4 a	61.7 a	19.1 c

* Numbers within a column followed by the same small letter are not significantly different according to a least significant difference test ($P \leq 0.05$).

Table 2a. Disease ratings and yield parameters for TILT timing applications from Melfort, SK*.

Chemical	36354 McFadden 0	36374 Flag %**	Flag-1 %	Flag-2 %	McFadden 0-11
Untreated	3.6 abc	13.5 ab	29.3 ab	75.3 a	8.5 ab
TILT - GS 31	1.6 cd	9.2 ab	22.8 bc	63.9 a	8.3 abc
TILT - GS 37	0.9 d	10.0 ab	7.1 d	11.8 b	5.3 d
TILT - GS 47	5.2 a	16.2 a	35.2 ab	79.9 a	8.8 a
TILT - GS 65	5.1 a	5.8 b	6.5 d	37.4 b	7.0 c
½ TILT - GS 47	4.6 ab	17.2 a	40.8 a	77.6 a	9.0 a
½ TILT - GS 47 & 65	2.8 bcd	6.6 b	9.0 cd	34.4 b	7.3 bc

Table 2b. Disease ratings and yield parameters for TILT timing applications from Melfort, SK*.

Chemical	Yield kg/ha	1000 Kernel Wt g	Bushel Wt kg/hl	Thins %
Untreated	3255	33.8	53.1	33.3 abc
TILT - GS 31	2991	34.3	51.9	35.3 a
TILT - GS 37	3622	36.1	54.4	26.8 bc
TILT - GS 47	2913	34	51.6	38.5 a
TILT - GS 65	3707	37.2	54.9	25.8 c
½ TILT - GS 47	3287	36.3	52.8	34.8 ab
½ TILT - GS 47 & 65	3859	36	53.6	31.0 abc

* Numbers within a column followed by the same small letter are not significantly different according to a least significant difference test ($P \leq 0.05$).

** % = Grade formula % based on the Horsfall-Barratt Scale.

1999 PMR REPORT # 120 SECTION N: CEREALS, FORAGE CROPS AND OILSEED DISEASES
STUDY DATA BASE: 375-1113-9613

CROP: Field pea (*Pisum sativum* L.), cv. Swing
Barley (*Hordeum vulgare* L.), cv. AC Oxbow
Wheat (*Triticum aestivum* L.), cv. AC Barrie
Canola (*Brassica napus* L.), cv. Exceed

PEST: Mycosphaerella blight, *Mycosphaerella pinodes* (Berk. & Blox.) Vestergr. / *Phoma medicaginis* Malbr. & Roum. var. *pinodella* (Jones) Boerema
Net blotch, *Pyrenophora teres* Drechs.
Septoria complex, *Septoria tritici* Rob. In Desm. and *S. nodorum* (Berk.) Berk.
Tan spot, *Pyrenophora tritici-repentis* (Died.) Drechs.
Sclerotinia stem rot, *Sclerotinia sclerotiorum* (Lib.) De Bary
Blackleg, *Leptosphaeria maculans* (Desm.) Ces and de Not

NAME AND AGENCY:
MARTIN K, KUTCHER H R, JOHNSTON A, and KIRKHAM C
Agriculture and Agri-Food Canada, Melfort Research Farm
Box 1240, Melfort, Saskatchewan SOE 1AO
Tel: (306) 752-2776 Fax: (306) 752-4911 Email: martink@em.agr.ca

TITLE: MANAGING DISEASES IN THE PARKLAND WITH FUNGICIDES, ROTATION, AND TILLAGE

MATERIALS: QUADRIS (azoxystrobin 250 g.ai./L SC), RONILAN (50% vinclozolin EG), TILT (propiconazole, 250 g. ai./L EC).

METHODS: This trial (established in 1994) was continued at Melfort Research Farm in 1999. A split-split plot design was used with three tillage systems (conventional, minimum and zero) as main-plots, three rotations (canola, wheat, barley, barley; canola, barley, pea, wheat; canola, pea, flax, barley) as sub-plots and fungicide treatments as sub-sub plots. There were four replications with each phase of the rotations occurring every year. Each sub plot was 15m x 18m. Tillage was conducted with a medium duty cultivator with 28cm sweeps and 20cm shank spacing. Pea seed was inoculated with granular rhizobium inoculant at 5 kg/ha. All plots were seeded between May 25 and June 18 with a 3.7 m pneumatic plot seeder with fertilizer side banded (2.5 cm to the side and 6.5 cm below the seed) at seeding. Canola was sprayed with QUADRIS at 125 g ai/ha in 100L/ha of water at the 2-3 leaf stage then sprayed with RONILAN at 500 g ai/ha in 100L/ha of water. Peas were sprayed with QUADRIS at 175 g ai/ha at first flower in 100L/ha of water. TILT was sprayed on wheat and barley at 125 g ai/ha at flag leaf emergence in 200L/ha of water. All fungicides were sprayed with a Hardy three-point hitch sprayer equipped with 8002 tee-jet flat fan nozzles. The experiment was damaged by hail on August 5, which likely was responsible for the lower yields recorded in 1999 than in other years. Peas were to be assessed for mycosphaerella blight but hail damage made accurate assessment impossible. Mycosphaerella blight symptoms were observed on the pea crop prior to hail damage. Canola was assessed for blackleg and sclerotinia incidence (%) based on the number of infected plants in a sample of

100 evaluated just prior to swathing. Cereals were assessed for foliar diseases on a 0-11 scale based on the percentage of leaf area diseased (0 - no disease, 11 - 100% leaf area infected) on 25 plants/plot at the milk stage of kernel development. Yields were recorded for each plot.

RESULTS: Disease assessments and yields of crops are presented in Table 1.

CONCLUSIONS: Tillage system and rotation had little impact on disease infestation of crops in 1999. Application of TILT reduced disease severity in wheat and barley and increased yields. Application of QUADRIS to peas increased yield. Blackleg incidence was reduced with application of QUADRIS but sclerotinia incidence was unchanged by RONILAN application. Yield of canola was increased on plots treated with fungicides.

Table 1. Effect of fungicide treatment on disease severity and yield of barley and wheat (leaf spots), canola (disease incidence of blackleg (BL) and sclerotinia stem rot (SSR)) and peas (mycosphaerella blight).

	Barley	Wheat	Canola		Pea
	(0-11)	(0-11)	BL (%)	SSR (%)	
Disease Rating					
Control	6.4	8.3	55.1	12.7	-
Fungicide	4.7	5.4	47.5	11.8	-
$Lsd_{(0.05)}$	0.4*	0.6*	4.7*	2.1	-
Yield (kg/ha)					
Control	2679	2023	1078		2011
Fungicide	3022	2277	1242		2204
$Lsd_{(0.05)}$	69*	132*	74*		142*

* significant at P = 0.05.

1999 PMR REPORT # 121 SECTION N: CEREAL, FORAGE, AND OILSEED CROPS
ICAR: 61006537

CROP: Corn, cv. Pioneer Hi-Bred 36D14, 36W38
PEST: Corn seedling diseases

NAME AND AGENCY:
SCHAAFSMA A W and HOOKER D C
Ridgetown College of Agricultural Technology
Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: INFLUENCE OF CORN SEED TREATMENTS IN NO-TILL

MATERIALS: VITAFLO (thiram + carbathiin, 148 + 167 g L^{-1}); APRON XL (metalaxyl-m, 369 g L^{-1}); MAXIM 480 (fludioxinil, 480 g L^{-1}); MAXIM XL 324 (fludioxinil + mefenoxam, 231 + 93 g L^{-1}); ADAGE (thiamethoxam, 600 g L^{-1}).

METHODS: Seed treatments were applied to 1 kg lots of seed corn in plastic bags as a slurry with a syringe, and mixed for at least one minute or until coverage was uniform. No-till fields were selected near London and Ridgetown with corn as the previous crop. Pioneer 36D14 was planted at Ridgetown on 12 May 1999 and Pioneer 38W36 was planted at London on 10 May 1999, with a no-till planter equipped with modified Gustafson seeder units. The seeds were planted in 0.76 m rows at the rate of 65 000 seeds ha^{-1}. The plots at each location were arranged in a randomized complete block design with 4 replications. Each plot was 3 m wide and 10 m in length. Corn emergence and vigour was first measured shortly after planting at both locations; the number of corn plants emerged in 4 m of row was recorded on 26 May at Ridgetown, and on 31 May at London. Final corn seedling emergence was recorded on 21 June at Ridgetown, and on 18 June at London. Corn seedling vigour was rated on a scale of 1 to 9, with 9 being the best rating. Grain yield was measured from 10 m of the 2 centre rows of each plot, and adjusted to 15.5 % moisture content for presentation purposes.

RESULTS AND CONCLUSIONS: Soil conditions were warm and dry during May and June at both locations. There were no significant differences among seed treatments, or between treated and untreated control plots.

Table 1. Corn response to seed treatments at Ridgetown, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	8.0	9.8	7.0	7.88
MAXIM XL 324	10.8	7.3	8.5	6.8	7.88
MAXIM XL 324 + ADAGE 600	10.8 5.0	8.3	9.0	7.0	8.32
MAXIM XL 324 + ADAGE 600	10.8 8.3	7.8	10.3	5.3	6.48
MAXIM 480 + APRON XL 369	5.2 2.7	8.3	9.8	8.3	7.92
VITAFLO 280	280	7.3	9.0	6.3	7.58
LSD (0.05)		NS	NS	NS	NS
CV (%)		13.1	9.7	21.4	14.1
ANOVA F Ratio (*P*)		0.49	0.12	0.16	0.28

* 1-9 where 1 is poor and 9 is good vigour.

Table 2. Corn response to seed treatments at London, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	7.4	7.2	6.3	5.36
MAXIM XL 324	10.8	9.1	8.7	8.1	5.20
Maxim XL 324 + ADAGE 600	10.8 5.0	8.1	8.4	9.0	5.93
MAXIM XL 324 + ADAGE 600	10.8 8.3	8.1	7.8	8.1	5.22
MAXIM 480 + APRON XL 369	5.2 2.7	9.3	9.3	8.1	5.01
VITAFLO 280	280	8.1	8.4	7.2	5.24
LSD (0.05)		NS	NS	NS	NS
CV (%)		17.7	13.4	16.5	9.6
ANOVA F Ratio (*P*)		0.48	0.19	0.12	0.23

* 1-9 where 1 is poor and 9 is good vigour.

1999 PMR REPORT # 122 SECTION N: DISEASES OF CEREALS, FORAGE CROPS AND OILSEEDS
ICAR: 3500-2507

CROP: Soybean (*Glycine max* (L.) Merr.) Cvs. S24-92, Sterling
PEST: Phytophthora rot (*Phytophthora sojae* {Kauf. & Gerd.})

NAME AND AGENCY:
ANDERSON, T R
Agriculture & Agri-Food Canada, Greenhouse & Processing Crops Research Centre
2585 County Road 20, Harrow, ON N0R 1G0
Tel: (519) 738-2251 ext. 426 Fax: (519) 738-2929 Email: andersont@em.agr.ca

TITLE: EFFICACY OF SEED TREATMENTS FOR CONTROL OF PHYTOPHTHORA ROT OF SOYBEANS IN NATURALLY INFESTED FIELD SOIL IN ESSEX COUNTY, ONTARIO

MATERIALS: MAXIM (fludioxonil 480 g a.i./l), APRON XL (metalaxyl-m 369 g a.i./l), APRON MAXX (metalaxyl-m/fludioxonil 240.5 g a.i./ L), APRON XL/MAXIM (metalaxyl-m/fludioxonil/difenaconazole 73 g a.i./l Ratio: 24.9/8.3/39.8), VITAFLO 280 (carbathiin 149 g a.i./ l, thiram 132 g a.i./l)

METHODS: Seed treatments (Table 1) were applied to soybean cvs. S24-20 (tolerant to root rot) and Sterling (moderatly tolerant to root rot) with sufficient distilled water to cover seed throughly. air dried, packaged and stored at 3• C, 24 hr prior to planting. Plots consisted of 4 rows, 4.5 m in length with 100 seeds/row. Plots were replicated 4X in a randomized block design. Data was collected on the centre 2 rows of each plot. Experiments were planted 1999/06/05 at Woodslee and 1999/06/04 at Harrow. Both sites consisted of fine textured soil (clay loam) with prior histories of root rot. Plots were harvested 1999/10/07 at Woodslee and 1999/09/08 at Harrow. Weed control was obtained with DUAL (2.6 kg ai/ ha) + PURSUIT (0.1 kg ai/ ha). Plant loss was determined from the difference between plant counts at emergence (Woodslee, 1999/07/06: Harrow, 1999/07/08) and final stand (Woodslee,1999/08/03: Harrow, 1999/08/06). Vigour ratings were made 17 and 32 days after planting at Woodslee and 14 and 20 days after planting at Harrow. Fifteen plants were collected from the border rows of control plots 1999/08/04 to obtain information on fungal pathogens present at each site. Lower stems and roots were surface sterilized and plated on acidified potato dextrose agar. Fungi were identified after 5 days incubation.

RESULTS: Differences between treatments were more evident at Woodslee than at Harrow. Emergence, vigour and yield of Sterling were lower than S24-94 at both locations and plant loss due to Phytophthora was higher for Sterling at each location. Drought conditions in July and August may account for lower yields of both varieties at Woodslee. Seed treatments had a significant effect on emergence, vigour and plant loss at Woodslee and emergence and plant loss at Harrow. Treatments (9) and (10) promoted yield and vigour in general. Seed treatments had a significant effect on emergence of Sterling at Woodslee but only treatment (21) improved emergence at Harrow. In general, vigour of Sterling was improved at both sites by seed treatments. There was no significant affect on yield at either site.

Based on symptoms on diseased seedlings and the known susceptibility of the two varieties, Phytophthora was the most important pathogen causing plant loss at both sites. The additional fungal pathogens isolated in August (*Diaporthe, Fusarium* and *Macrophomina*) were not evident during the seedling stage of growth but they may have affected overall results.

CONCLUSIONS: Seed treatments containing metalaxyl-M and fludioxonil were effective in improving soybean vigour and reducing plant loss at Woodslee caused primarily by *Phytophthora sojae* with the soybean cultivar Sterling which is moderately tolerant to Phytophthora rot. Differences in seed treatments were not as evident at Harrow or with S24-94 which is more tolerant to Phytophthora rot.

Acknowledgments: Thanks to Novartis and the Matching Investment Initiative for financial support and to Chuck Meharg, Elaine Lepp, Sharon Johnson and summer students for technical support.

Table 1. Effect of seed treatments on emergence, vigour, plant loss and yield of two soybean varieties at Harrow.

Treatment			Rate g a.i./ 100 kg seed	Emerg. (%)	Vigour(1) (1-5)	Vigour (II) (1-5)	Plant loss (%)	Yield kg/ha
1	S24-94	Control	0	76	4.5	3.8	0.8	2278
2		MAXIM	2.5	80	4	3.5	1.8	2537
3		APRON XL	3.75	79	3.5	3.5	2.7	2547
4		APRON XL	7.5	85	4.5	3.8	2.2	2402
5		APRON XL + MAXIM	3.75+ 2.5	81	3.8	3.5	1.7	2274
6		APRON XL + MAXIM	7.5 + 2.5	84	4.3	3.8	1.5	2539
7		APRON XL + MAXIM	15 + 2.5	84	3.8	3.5	4.5	2478
8		APRON MAXX	3.75/2.5	86	4	4	1.9	2568
9		APRON MAXX+ APRON XL	3.75/2.5+ 11.25	92	4.5	4	2	2642
10		APRON XL/ MAXIM/DIVIDEND	7.5 + 2.5+ 12	86	4.3	4	1.6	2727
11		VITAFLO	41.7+36.9	84	4.3	3.8	1.2	2469
12	Sterling	Control	0	61	3.3	3.3	20	2343
13		MAXIM	2.5	64	3	2.3	18.9	1866
14		APRON XL	3.75	71	3.8	3	13.8	2168
15		APRON XL	7.5	72	3.5	3.3	8.8	2314
16		APRON XL + MAXIM	3.75 + 2.5	69	3.3	3	11.2	2218
17		APRON XL + MAXIM	7.5 + 2.5	70	3.3	2.5	12.5	2152
18		APRON XL + MAXIM	15 + 2.5	72	3.3	3.3	9.5	2149
19		APRON MAXX	3.75/2.5	72	3	3	10.7	2451
20		APRON MAXX+ APRON XL	3.75/2.5 + 11.25	72	3.8	3.5	6.8	2446
21		APRON XL/ MAXIM/DIVIDEND	7.5 + 2.5+ 12	78	3.5	3.5	14.9	2423
22		VITAFLO	41.7 + 36.9	70	3	2.3	16.4	2049
•				76.6	3.7	3.4	7.5	2365
Pr>F			0.02	0	0	0	0	0.32
LSD 0.05				13.6	1.2	1.1	4.9	456
CV (%)				15	27.5	27.2	55.6	16.3

Table 2. Effect of seed treatments on emergence, vigour, plant loss and yield of two soybean varieties at Woodslee.

Treatment			Rate g a.i./ 100 kg seed	Emerg. (%)	Vigour (I) (1-5)	Vigour (II) (1-5)	Plant loss (%)	Yield kg/ha
1	S24-94	Control	0	92	4.5	4.5	3	1717
2		MAXIM	2.5	93	4.5	4.8	1	1594
3		APRON XL	3.75	97	5	4.8	2	1511
4		APRON XL	7.5	97	4.8	4.8	3	1709
5		APRON XL + MAXIM	3.75+ 2.5	91	3.8	3.8	5	1523
6		APRON XL + MAXIM	7.5 + 2.5	93	4.3	4.3	3	1581
7		APRON XL + MAXIM	15 + 2.5	94	4.8	4.8	2	1682
8		APRON MAXX	3.75/2.5	93	4.5	4	1	1454
9		APRON MAXX+ APRON XL	3.75/2.5+ 11.25	94	4.8	4.5	4	1689
10		APRON XL/ MAXIM/DIVIDEND	7.5 + 2.5+ 12	92	4.8	4.3	1	1621
11		VITAFLO	41.7+36.9	99	4.8	4.8	2	1735
12	Sterling	Control	0	73	3	2.3	21	1495
13		MAXIM	2.5	81	3.3	2.8	17	1494
14		APRON XL	3.75	82	3	3.3	7	1551
15		APRON XL	7.5	80	3.3	2.8	5	1350
16		APRON XL + MAXIM	3.75 + 2.5	84	3	3	8	1456
17		APRON XL + MAXIM	7.5 + 2.5	80	3.3	2.8	5	1507
18		APRON XL + MAXIM	15 + 2.5	84	3.5	3.5	8	1429
19		APRON MAXX	3.75/2.5	94	4	2.8	8	1610
20		APRON MAXX+ APRON XL	3.75/2.5 + 11.25	80	3	3.5	4	1444
21		APRON XL/ MAXIM/DIVIDEND	7.5 + 2.5 + 12	89	3.5	3	8	1424
22		VITAFLO	41.7 + 36.9	87	3.5	2.5	26	1479
•				88.4	3.9	3.7	3.9	1548
Pr>F			0.02	0.49	0.22	0	0	0.18
LSD 0.05				5.9	0.7	0.9	0.7	223
CV (%)				5.7	14.5	19.7	112.3	12.2

1999 PMR REPORT # 123 SECTION N: CEREAL, FORAGE, AND OILSEED CROPS
ICAR: 61006537

CROP: Soybean, cv. Southwest Seeds SW3308, Hyland T8508, NK S-0880
PEST: Soybean diseases

NAME AND AGENCY:
SCHAAFSMA A W and HOOKER D C
Ridgetown College of Agricultural Technology
Ridgetown, Ontario, N0P 2C0
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: INFLUENCE OF SOYBEAN SEED TREATMENTS IN NO-TILL

MATERIALS: VITAFLO 280 (thiram + carbathiin,148 + 167 g L^{-1});
APRON XL 369 (metalaxyl-m 369 g L^{-1}); APRONMAXX (fludioxinil + metalaxyl-m, 96.5 + 144 g L^{-1});
MAXIM 480 (fludioxinil; 480 g L^{-1}); fludioxonil/metalaxyl-M/difenoconazole 73 g L^{-1}, N002/99WP
(diazonon + captan, 35.2 + 17.2 g L^{-1})

METHODS: Seed treatments were applied to 1 kg lots of soybean seed, in plastic bags as a slurry with a syringe, and mixed for at least one minute until coverage was uniform. No-till fields were selected near London and Ridgetown with soybean as the previous crop. Soybeans were planted on two different dates. A full-season variety and a late-maturing variety was planted on 11 May at Ridgetown and 10 May at London on an early date; the full-season variety for each location was planted on 21 May at Ridgetown and 20 May at London on an adjacent area to the early-planted soybeans. At Ridgetown, the full-season variety was Hyland T8508 and the late-maturing variety was Southwest Seeds SW3308. At London, the full-season variety was NK S-0880 and late-maturing variety was Hyland T8508. Plots for each planting date were arranged in a randomized complete block design with 4 replications. Each plot was 3 m wide and 10 m in length. Soybeans were seeded at the rate of 30 seeds per metre in 0.76 m-wide-rows with a no-till planter equipped with modified Gustafson seeder units. Soybean vigour and emergence was measured in 6 m of row in all plots; this occurred on 27 May for the early planting, and 16 June for the late planting at Ridgetown, and on 31 May and 18 June for the early and late planting at London. Soybean vigour was rated on a scale from 1 to 9, with 9 being the best vigour. Final soybean emergence was recorded on 16 June for the early planting, and 24 June for the late planting at Ridgetown, and on 31 May and 18 June for the early and late planting at London. Soybean seed yields were determined by machine harvesting 10 m of the 2 centre rows of each plot; yields were adjusted to 14% moisture for presentation purposes.

RESULTS AND CONCLUSIONS: Soil conditions were warm and dry during May and June at both locations. Most seed treatments did not enhance emergence or final stands compared to the untreated check across locations, planting dates, and varieties; however, some treatments appeared to delay emergence at some locations, but the effect was not consistent across both locations. There were few differences in soybean vigour among seed treatments. No diseases were observed on the roots of soybean seedlings grown from untreated seed. The late maturing soybean variety yielded at least 10% better than the full-season variety at both locations.

Table 1. Full-season soybean variety Hyland T8508 response to seed treatments when planted on the early date (11 May) at Ridgetown, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	16	25	7.2	1.80
N002/99WP	320	11	26	4.1	1.58
APRON XL 369 + MAXIM 480	10.2 5.2	14	26	6.8	1.70
APRON XL 369 + MAXIM 480	20.4 5.2	12	24	5.4	1.67
APRONMAXX	26	15	23	7.2	1.63
VITAFLO 280	280	15	27	5.0	1.75
LSD (0.05)		NS	NS	NS	NS
CV (%)		28.5	8.8	48	13.5
ANOVA F Ratio (*P*)		0.22	0.29	0.53	0.76

* 1 is poor and 9 is best.

Table 2. Full-season soybean variety NK S-0880 response to seed treatments when planted on the early date (10 May) at London, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	20	20	4.3	2.40
APRON XL 369 + MAXIM 480	10.2 5.2	20	21	5.0	2.28
APRON XL 369 + MAXIM 480	20.4 5.2	23	23	5.8	2.70
APRONMAXX	26	22	21	4.3	2.57
VITAFLO 280	280	23	23	5.8	2.75
LSD (0.05)		NS	1.9	NS	NS
CV (%)		8.2	5.7	19.5	10.4
ANOVA F Ratio (*P*)		0.06	0.01	0.11	0.12

* 1 is poor and 9 is best.

Table 3. Late soybean variety SouthWest Seeds SW3308 response to seed treatments when planted on the early date (11 May) at Ridgetown, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
UNTREATED	-	28	28	4.0	2.25
N002/99WP	320	29	29	4.5	2.10
MAXIM 480	5.2	29	27	5.0	1.82
APRON XL 369	10.2	28	28	5.0	1.82
APRON XL 369	20.4	29	28	3.8	2.20
APRON XL 369 + MAXIM 480	10.2 5.2	25	27	3.5	2.22
APRON XL 369 + MAXIM 480	20.4 5.2	26	27	4.0	2.02
APRONMAXX	26	30	29	4.0	2.23
APRONMAXX + APRON XL 369	26 30.5	28	27	4.5	1.88
Flud./Met-M./Dif.	300	26	29	4.5	2.45
Flud./Met-M./Dif. + ADAGE 600	300 50	30	28	4.8	1.98
Flud./Met-M./Dif. +ADAGE 600	300 83	28	28	5.0	1.78
VITAFLO 280	280	30	27	4.5	2.10
LSD (0.05)		3.4	NS	NS	NS
CV (%)		8.4	7.9	26.8	19.2
ANOVA F Ratio (*P*)		0.04	0.97	0.82	0.61

[z] where 1 is poor and 9 is best.

Table 4. Late-maturing soybean variety Hyland T8508 response to seed treatments when planted on the early date (10 May) at London, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	23	26	4.3	2.35
N002/99WP	320	25	27	4.3	2.57
MAXIM 480	5.2	22	26	5.3	2.35
APRON XL 369	10.2	27	28	5.3	2.45
APRON XL 369	20.4	26	27	5.3	2.47
APRON XL 369 + MAXIM 480	10.2 5.2	23	26	5.0	2.18
APRON XL 369 + MAXIM 480	20.4 5.2	26	28	5.5	2.33
APRONMAXX	26	26	27	5.5	2.40
APRONMAXX + APRON XL 369	26 30.5	26	28	4.8	2.53
Flud./Met-M./Dif.	300	26	27	4.8	2.70
Flud./Met-M./Dif. + ADAGE 600	300 50	23	27	4.3	2.57
Flud./Met-M./Dif. +ADAGE 600	300 83	21	28	4.0	2.33
VITAFLO 280	280	25	27	5.3	2.55
LSD (0.05)		2.1	NS	NS	NS
CV (%)		8.7	7.5	23.7	10.3
ANOVA F Ratio (*P*)		0.01	0.8	0.65	0.27

* 1 is poor and 9 is best.

Table 5. Full-season soybean variety Hyland T8508 response to seed treatments when planted on the late date (21 May) at Ridgetown, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	26	27	4.5	2.35
N002/99WP	320	28	29	4.5	2.55
APRON XL 369 + MAXIM 480	10.2 5.2	27	30	3.8	2.25
APRON XL 369 + MAXIM 480	20.4 5.2	28	29	5.3	2.17
APRONMAXX	26	29	29	5.5	2.55
VITAFLO 280	280	28	29	5.5	2.47
LSD (0.05)		NS	NS	1.2	NS
CV (%)		5.8	7.1	16.2	11.4
ANOVA F Ratio (*P*)		0.19	0.55	0.04	0.29

* 1 is poor and 9 is best.

Table 6. Full-season soybean variety NK S-0880 response to seed treatments when planted on the late date (20 May) at London, 1999.

Treatment	Product Rate	Emergence		Seedling Vigour	Grain Yield
		Initial	Final		
	mL or g 100 kg^{-1} seed	----- m^{-1} row -----		1-9*	Mg ha^{-1}
Untreated	-	24	27	6.4	2.10
N002/99WP	320	23	26	8.0	2.30
APRON XL 369 + MAXIM 480	10.2 5.2	25	30	6.4	2.17
APRON XL 369 + MAXIM 480	20.4 5.2	27	27	6.4	2.28
APRONMAXX	26	23	27	6.4	2.26
VITAFLO 280	280	23	27	7.7	2.47
LSD (0.05)		NS	NS	NS	NS
CV (%)		11.7	8.5	24.3	14.0
ANOVA F Ratio (*P*)		0.31	0.33	0.58	0.65

* 1 is poor and 9 is best.

1999 PMR REPORT # 124 SECTION N: DISEASES OF CEREALS, FORAGE LEGUMES AND OILSEEDS
STUDY DATA BASE or ICAR #: 463-1211-9604

CROP: Wheat (*Triticum aestivum* L.) cv. CDCTeal, ES4
PEST: Tan spot (*Pyrenophora tritici-repentis* (Died.) Drechs., anamorph *Drechslera tritici-repentis* (Died.) Shoem.)

1. NAME AND AGENCY:

GILBERT, J.
Agriculture and Agri-Food Canada, Cereal Research Centre, 195 Dafoe Road, Winnipeg MB, R3T 2M9
Tel: (204) 983-0891 Fax: (204) 983-4604 E-mail: jgilbert@em.agr.ca

TITLE: EFFICACY OF ICIA5504 250SC (AZOXYSTROBIN) FOR CONTROL OF TAN SPOT ON WHEAT: ARTIFICIALLY INOCULATED FIELD TRIALS AT GLENLEA, MANITOBA, IN 1998 and 1999.

MATERIALS: ICIA5504 250SC (azoxystrobin) TILT (propiconazole 250EC).

METHODS: Registered spring wheats, CDCTeal (Canada western red spring) and ES4 (Canada western extra strong) were planted in an irrigated site at Glenlea, Manitoba, June 2, 1998 and June 4, 1999. Plots were of 7, 3 m long rows with 15 cm row spacing planted in a randomized complete block design. The test included 6 treatments replicated 4 times. ICIA5504 was applied at 3 rates: 75, 100, and 125 gai/ha. TILT was applied at 125 gai/ha. Two additional treatments included non-inoculated and inoculated checks. All plots, except the non-inoculated check, were inoculated twice with an aqueous conidial suspension of *Pyrenophora tritici-repentis* at 3000 conidia/mL at Zadoks Growth Stage (ZGS) 30, end of tillering, (July14 and16, 1998, and July 8 and 10, 1999). Plots were misted after inoculation and the following morning to promote disease development. All fungicide treatments were applied at ZGS 37, flag leaf still rolled (July 20, 1998 and July 17,1999). Three weeks after inoculation, flag leaves were rated for disease severity using both a quantitative (percent leaf area with lesions) and a qualitative scale describing lesion type (1 to 5, R to S. Lamari & Bernier 1989). Plot yield and grain weight were recorded for each plot. Data were analyzed using Proc-GLM (SAS Institute, Cary, North Carolina 1996).

RESULTS: Error variances for percent leaf area with disease symptoms were not equal for the two years and data are presented separately (Table 1). In 1998, fungicide-treated plots scored lower percent disease severity on flag leaves than the checks. In 1999, fungicide treatment reduced percent flag leaf area with disease symptoms, but the result was not significantly different from the inoculated check. Error variance was equal for lesion type, yield and grain weight, and 1998 and 1999 data for these variables were combined for analysis (Table 2). Inoculated and non-inoculated checks did not differ from each other. Fungicide treated plots had smaller lesions than the checks, but plot yields did not differ. Thousand-kernel weight was different for each variety ($P \leq 0.05$) but treatment differences were not significant.

CONCLUSIONS: Leaf spot severity was reduced by ICIA5504 at all three rates and was equal in effect to TILT, but in 1999 was not significantly different from the inoculated check. The 1999 data are probably skewed by the high levels of disease, caused by *Cochliobolus sativus*, found on the noninoculated check. Lower disease levels recorded in the inoculated check plots may be due to competition at the leaf surface between *Pyrenophora tritici-repentis*, cause of tan spot, and *C. sativus*, cause of spot blotch (da Luz and Bergstrom 1987). Lesions were significantly smaller on fungicide-treated flag leaves than on the controls. Higher plot yields occurred in plots treated with fungicide at the higher rates, but differences were not significant.

REFERENCES:

Lamari, L. & Bernier, C. C. 1989. Evaluation of wheat lines and cultivars to tan spot (*Pyrenophora tritici-repentis)* based on lesion type. Can. J. Plant Pathol. 11:49-56.

da Luz, W.C. & Bergstrom, G.C. 1987. Interactions between *Cochliobolus sativus* and *Pyrenophora tritici-repentis* on wheat leaves. Phytopathology 77:1355-1360.

Table 1. Least squares means for tan spot disease severity on flag leaves of spring wheats protected with ICIA5504 at three rates or TILT in 1998 and 1999.

Treatment	Rate	Disease Severity (% Flag leaf area with symptoms)	
		1998	1999
Inoculated Check		23.13 b*	31.9 a
Non-inoculated check		21.25 b	68.8 b
ICIA5504 250SC	75	12.50 a	25.0 a
ICIA5504 250SC	100	12.00 a	15.0 a
ICIA5504 250SC	125	11.00 a	15.0 a
TILT 250EC	125	12.38 a	21.3 a
Coefficient of Variation		29.89	75.46

* Means of 4 replications and 2 registered wheat cultivars. Numbers within a column followed by the same letter are not significantly different at P • 0.05 on a comparison-wise basis.

Table 2. Least squares means for tan spot lesion type on flag leaves, and plot yield and thousand-kernel weight (TKW) of spring wheats protected with ICIA5504 at three rates or TILT.

	Rate	Disease Severity	Yield	TKW (g)	
Treatment	g ai/ha	Lesion type (1-5, R-S)	g/plot	CDC Teal	ES 4
Inoculated Check		3.3 b*	1053	30.8 bc	41
Non-inoculated check		2.9 b	1102	31.9 ab	41
ICIA5504 250SC	75	2.1 a	1090	30.5 c	41.6
ICIA5504 250SC	100	2.0 a	1193	32.8 a	42.2
ICIA5504 250SC	125	2.3 a	1149	31.5 bc	41.1
TILT 250EC	125	1.9 a	1190	33.0 a	41.2
Coefficient of Variation				22.02	2.60
ANOVA				NS	NS

* Means of 4 replications and 2 registered wheat cultivars. Numbers within a column followed by the same letter are not significantly different at *P* • 0.05 on a comparison-wise basis.

1999 PMR REPORT # 125 SECTION N: DISEASE OF CEREALS, FORAGE CROPS AND OILSEEDS

CROP: Winter wheat (*Triticum aestivum* L.), cv. Unknown
PEST: Loose smut, *Ustilago tritici*

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: **SEED TREATMENTS TO CONTROL LOOSE SMUT IN WINTER WHEAT**

MATERIALS: VITAFLO 280 (thiram, 130 g a.i/L + carbathiin 150 g a.i. /L), DIVIDEND 360FS (difeconazole 360 g a.i./L), APRON XL (metalaxyl-m 369 g a.i/L), DIVIDEND XL (difeconazole 38.3 g a.i./L + metalaxyl 3.19 g a.i./L).

METHODS: Seed was obtained from non-treated, loose smut-infected plots from the previous season. Seed was treated on 13 October, 1998 in individual plastic bags and rolled until throughly covered, in 750 g lots. The crop was planted on 16 October, 1998 at Ridgetown, Ontario using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm, and 4 m in length placed in a randomized complete block design with four replications. The plots were fertilized and maintained according to Ontario provincial recommendations. The number of emerged plants in 1 m (2 rows), was determined on 29 October, 1998. Survival notes were taken on 31 March, 1999 on the same 1m strip (2 rows). Loose smut was evaluated at heading, on 8 June, 1999. The number of heads were estimated per plot by counting all the heads in 1m of row and then multiplying by the total row length of the plot. Total infected heads were counted per plot and these were expressed as a percentage of the total heads/plot. Yields were taken on 16 July, 1999 and corrected to 14% moisture.

RESULTS: The results are summarized in Table 1.

CONCLUSIONS: All the materials tested provided excellent control of loose smut. There was no significant effect on emergence, or on the number of tillers counted in the spring. DIVIDEND XL at the higher rate resulted in a significant increase in yield plus the lowest smut counts.

Table 1. Emergence, survival, percent heads infected, and yield of winter wheat treated with fungicides for the control of loose smut, Ridgetown, Ontario, 1999.

Seed treatment	(mL product/ kg seed)	Emergence (plants/2m)	Survival (Tillers/2m)	Percent loose smut	Yield (Tonne/ha)
VITAFLO 280	3.33	154.0	133.3	4.8	5.78
DIVIDEND 360FS	0.33	163.0	122.8	4.0	5.82
+ APRON XL	0.03				
DIVIDEND XL	0.65	169.8	133.5	1.0	5.82
DIVIDEND XL	1.30	161.0	133.0	0.5	6.02
CONTROL		162.3	120.0	24.3	5.56
LSD		20.9	29.4	3.8	0.3
CV (%)		8.4	14.9	35.4	3.8

1999 PMR REPORT # 126 SECTION N: DISEASE OF CEREALS, FORAGE CROPS AND OILSEEDS

CROP: Winter wheat (*Triticum aestivum* L.), cv. Pioneer 2510
PEST: Powdery mildew, *Erysiphe graminis* f. sp. *tritici*

NAME AND AGENCY:

SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: SEED TREATMENTS TO CONTROL POWDERY MILDEW IN WINTER WHEAT

MATERIALS: UBI 2584-3 (tebuconazole 0.708 % w/w), UBI 2568 (triadimenol 5.57 %), UBI 2051-10 (thiram 14 % + carbathiin 16 %), Z0007 (0.3 % triadimenol uncoated fertilizer), Z0008 (0.3 % triadimenol coated fertilizer), Z0009 (0.15 % triadimenol coated fertilizer), Z0010 (0.3 % triadimenol millett).

METHODS: Seed was treated on 13 October, 1998 in individual plastic bags and rolled until throughly covered, in 750 g lots. The crop was planted on 15 October, 1998 at Huron Research Station, Centralia, Ontario, and on 16 October, 1998 at Ridgetown, Ontario, using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm, and 4 m in length, placed in a randomized complete block design with four replications. The plots were fertilized and maintained according to Ontario provincial recommendations. The number of plants emerged in 1 m (2 rows), was determined on 30 October, 1998 at Ridgetown, and at Centralia. Survival notes were taken on 30 March, 1999 at Centralia and 31 March, 1999 at Ridgetown in the same 1m strip (2 rows). Powdery mildew infections were estimated as percentage of the area of each leaf covered with lesions for the same leaf position from 10 plants at random out of the center two rows of each plot on 18 May, 1999 at Centralia and 17 May, 1999 at Ridgetown. Plots at Centralia were trimmed back to 3.0 m before harvest. Yields were taken on 16 July, 1999 at both locations and corrected to 14% moisture.

RESULTS: The results are summarized in Table 1 and 2.

CONCLUSIONS: No significant differences in emergence and the number of tillers counted in the spring were observed between treatments and control at both locations. Emergence appeared to have been delayed in Centralia with most treatments. This was not reflected in tiller counts the following spring. Tiller counts were lower at Ridgetown with UBI 2051-1 at the higher rate, but this was not reflected in yield loss. Most treatments, with the exception of UBI 2584-3 and some UBI 2568 treatments at Ridgetown suppressed powdery mildew. Higher yields compared with non-treated controls were recorded in all treatments at Ridgetown, as well as at Centralia after application of UBI 2568 (2.5 mL/kg).

Table 1. Emergence, survival and yield of winter wheat where seed was treated with fungicides for the control of powdery mildew. Ridgetown, Ontario, 1999.

Seed Treatment	(mL product/ kg seed)	Emergence (Plants /2m)	Survival (Tillers /2m)	Percent powdery mildew	Yield (T/ha)
UBI 2584-3	2.50	146.3	122.8	17.9	6.6
UBI 2051-10	3.30	186.8	129.8	12.5	6.5
UBI 2051-10	1.70	151.0	106.5	16.3	6.4
UBI 2568	5.00	150.3	115.8	10.5	6.7
UBI 2568	4.20	137.0	118.5	11.7	6.8
UBI 2568	3.30	136.5	127.8	10.2	6.8
UBI 2568	2.50	158.3	126.8	9.9	6.8
UBI 2568	1.70	148.3	119.3	11.5	6.8
UBI 2584-3 +	2.50	136.8	115.5	4.1	6.7
Z0007 granular	1.00*				
UBI 2584-3 +	2.50	154.8	124.0	16.1	6.7
Z0008 granular	1.00*				
UBI 2584-3 +	2.50	150.3	125.0	14.5	6.7
Z0009 granular	1.00*				
UBI 2584-3 +	2.50	147.5	131.5	17.3	6
Z0010 granular	1.00*				
CONTROL		146.5	131.5	17.3	6
LSD		35.7	17.8	6.0	0.3
CV (%)		16.6	10.2	33.0	3

* g/m²

Table 2. Emergence, survival and yield of winter wheat where seed was treated with fungicides for the control of powdery mildew. Centralia, Ontario, 1999.

Seed Treatment	(mL product/ kg seed)	Emergence (Plants /2m)	Survival (Tillers /2m)	Percent powdery mildew	Yield (T/ha)
UBI 2584-3	2.50	154.0	175.0	11.0	4.5
UBI 2051-10	3.30	152.3	203.3	11.7	4.5
UBI 2051-10	1.70	140.8	187.0	11.4	4.5
UBI 2568	5.00	139.3	188.8	6.3	4.4
UBI 2568	4.20	147.5	183.5	5.2	4.7
UBI 2568	3.30	141.8	190.8	6.8	4.6
UBI 2568	2.50	158.0	175.8	6.4	5
UBI 2568	1.70	154.8	187.8	8.7	4.4
CONTROL		181.3	189.8	15.9	4.5
LSD		24.8	53.3	2.9	0.4
CV (%)		11.2	19.5	22.0	6.6

1999 PMR REPORT # 127 SECTION N: DISEASE OF CEREALS, FORAGE CROPS AND OILSEEDS

CROP: Winter wheat (*Triticum aestivum* L.), cv. AC Ron
PEST: Fusarium seedling blight, *Fusarium graminearum* Schwabe

NAME AND AGENCY:
SCHAAFSMA A W, and TAMBURIC-ILINCIC L
Ridgetown College, University of Guelph, Ridgetown, Ontario NOP 2CO
Tel: (519) 674-1624 Fax: (519) 674-1600 Email: aschaafs@ridgetownc.uoguelph.ca

TITLE: SEED TREATMENTS TO CONTROL FUSARIUM SEEDLING BLIGHT IN WINTER WHEAT

MATERIALS: VITAFLO 280 (thiram, 130 g a.i./L + carbathiin 150 g a.i. /L),UBI 2584-3 (tebuconazole 0.708 % w/w), UBI 2568 (tridimenol 5.57 %), UBI 2051-10 (thiram 14 % + carbathiin 16 %), DIVIDEND 360FS (difeconazole 360 g a.i/L), DIVIDEND XL (difeconazole 38.3 g a.i/L+ metalaxyl 3.19 g a.i/L), APRON XL (metalaxyl-m 369 g a.i/L), EXP80472J (triticonazole 2.63 %), TADS (triticonazole 1.3 % + thiram 13.0 %), EXP80991A (ICIA5504 800 g/kg), MEFANOXAM (APRON XL 360 g a.i/L), APRON FL (metalaxyl 28.4% w/w), VITAVAX 200 (carbathiin 200 g a.i./L), UBI 2584-1 (tebuconazole 8.33 g a.i./L), MANEB (tebuconazole 2.56 g a.i./L).

METHODS: Seed was obtained from non-treated infected plots from the previous season. *Fusarium* damaged kernels were not removed. Seed was treated on 13 October, 1998 in individual plastic bags and rolled until throughly covered, in 750 g lots. The crop was planted on 15 October, 1998 at Huron Research Station, Centralia, Ontario and on 16 October, 1998 at Ridgetown, Ontario, using a 6-row cone seeder at 400 seeds/m^2. Plots were six rows planted at a row spacing of 17.8 cm and 4 m in length, in a randomized complete block design with four replications. The plots were fertilized and maintained according to the Ontario provincial recommendations. The number of emerged plants in 1 m (2 rows) was determined on 30 October, 1998 at both locations. Survival notes were taken on 30 March, 1999 at Centralia, and 31 March 1999 at Ridgetown in the same 1 m strip (2 rows) as with emergence data. Plots at Centralia were trimmed back to 3.0 m before harvest. Yields were taken on 16 July, 1999 at both locations and corrected to 14% moisture.

RESULTS: Results are presented in Table 1 below.

CONCLUSIONS: At Centralia VITAFLO 280 significantly improved emergence, while DIVIDEND XL (0.65 mL/kg), and UBI 2584-1 (2.5 mL/kg) significantly improved yield. However the number of tillers in the spring was not significantly different between the treatments and control at either locations.

Table 1. Emergence, survival and yield of winter wheat where seed was treated with fungicides for the control of *Fusarium* seedling blight. Centralia and Ridgetown, Ontario, 1999.

Seed treatment	(mL product /kg seed)	Emergence	(Plants /2m)	Survival	(Tillers/2m)	Yield	(Tonne /ha)
		Centralia	Ridgetown	Centralia	Ridgetown	Centralia	Ridgetown
VITAFLO 280	3.33	172.8	148.5	147.8	138.3	4.33	6.13
UBI 2584-1	2.50	131.8	159.9	102.0	133.6	4.53	6.5
UBI 2051-10	3.30	132.0	159.8	116.3	132.0	4.35	6.32
UBI 2568 UBI 2584-3	1.25 1.25	132.5	163.5	114.8	123.3	4.32	6.30
UBI 2584-3 UBI 2051-10	1.25 3.30	149.3	132.5	132.8	120.3	4.07	6.53
DIVIDEND 360FS	0.33	145.0	148.5	123.3	136.0	4.50	6.2
DIVIDEND XL	1.30	146.5	149.8	107.5	118.8	4.63	6.2
DIVIDEND XL	0.65	144.5	141.8	118.4	145.0	4.57	6.15
MEFANOXAM DIVIDEND XL	0.03 0.36	132.5	159.3	114.4	129.8	4.43	6.10
EXP80472J APRON FL	2.10 0.07	133.5	166.3	102.4	146.8	4.35	6.10
EXP80472J APRON FL	4.20 0.07	141.5	141.8	105.8	134.0	4.45	6.28
EXP80472J MANEB	2.10 3.30	129.8	158.3	108.8	136.5	4.50	6.30
EXP80472J EXP80991A APRON FL	2.10 0.09 0.07	140.8	139.3	120.0	126.5	4.45	6.17
TADS 12403	3.80	153.0	137.0	125.8	140.0	4.47	6.28
VITAVAX 200	2.60	146.3	154.0	131.0	136.0	4.15	6.07
CONTROL		141.8	151.3	108.2	128.0	4.15	6.38
LSD		29.3	23.6	58.9	22.2	0.4	0.4
CV (%)		14.4	11.0	17.5	11.7	5.8	4.5

END OF SECTION N (Report #s 117-127, Pages 314-350).

NO REPORTS IN SECTION O.

SECTION P: **NEMATODES/ NÉMATODES**

REPORT /RAPPORT # 128

PAGES: 351 - 355

EDITOR **Dr. Joe Kimpinski**

Agriculture and Agri-Food Canada
Charlottetown Research Centre
440 University Avenue, P.O. Box 1210
Charlottetown, Prince Edward Island C1A 7M8

Email: kimpinskij@em.agr.ca
Tel: (902) 566-6851
Fax: (902) 566-6821

1999 PMR REPORT # 128 **SECTION P: NEMATODES**
ICAR: 206003

CROP: Carrot (*Daucus carota*), cvs. Bergen and Six Pak

PEST: Root Knot Nematode, *(Meloidogyne hapla)*
Lesion Nematode (*Pratylenchus penetrans*)
Pin Nematode (*Paratylenchus* spp)
Pythium Root Die Back (*Pythium* spp.)

NAME AND AGENCY:
MCDONALD M R, VANDER KOOI K AND JANSE S
Muck Crops Research Station, HRIO, Dept. of Plant Agriculture, University of Guelph
1125 Woodchoppers Lane, RR#1 Kettleby, Ontario L0G 1J0
Tel: (905) 775-3783 Fax: (905) 775- 4546 Email: mrmcdona@uoguelph.ca

TITLE: EVALUATION OF TELONE C-17 AND TELONE C-35 FOR THE CONTROL OF NEMATODES AND PYTHIUM ROOT DIE BACK, 1999

MATERIALS: TELONE C-17 (dichloropropene and chloropicrin), TELONE C-35 (dichloropropene and chloropicrin)

METHODS: The trial was established on two farms in Bradford, Ontario. Severe stunting caused by root knot nematode, *Meloidogyne hapla* and pythium root die back was noted in the fields in previous years during commercial production. Carrots were seeded on hills (86 cm apart) in organic peat soil (50% organic matter, pH 6.0) on 14 May (Site 1) and 25 May (Site 2)1999 using a tractor-mounted seeder. Treatments were four hills wide, 10 meters in length with four replications per treatment. Each treatment was applied under the center of each hill at a depth of 20 cm, using a John-Blue fumigator shank. TELONE C-17 and TELONE C-35 were applied at a rate of 34 L/ha product and 57 L/ha product. A check was included adjacent to each of the fumigated areas. Soil samples were taken on 12 July (Site 1) and 13 July (Site 2) to determine initial nematode populations and again at harvest on 20 September (Site 1) and 25 October (Site 2). Samples of 3.48 meters of row were harvested on 20 September (Site 1) and

25 October (Site 2). Carrots were graded for marketability, nematode damage and Pythium. The 0-5 scale rating from Beliar and Boivin 1988 was used to assess root knot nematode damage. The air temperatures were above the long term (10 year) average for June, July and September and below average for August. Total rainfall was below the long term (10 year) average for June (68.5 mm), July (71 mm) and August (78.8 mm) and above average for September (137.5 mm). Data were analyzed using the Gosset Paired T Test of the One, Two and Multi-sample Tests of Statistix, V. 4.1 and the General Analysis of Variance function of the Linear Models section of Statistix V.4.1.

RESULTS: As outlined in Tables 1-6.

CONCLUSIONS: TELONE C-17 and C-35 significantly increased the percent marketable in all treatments at both sites when comparing the treatments to their adjacent checks. There was a significant reduction of Pythium and root knot nematode damage in all treatments at Site 1.At Site 2 Pythium damage was lower in the treated plots compared to the checks however, not significantly (Tables 3 and 4). However, when comparing at all treatments TELONE C-17 at 57 L/ha and TELONE C-35 at 34 L/ha significantly reduced the percent of damage from Pythium at Site 2 (Table 6). TELONE C-17 at 57 L/ha and TELONE C-35 at 34 L/ha and 57 L/ha significantly increased the percentage of marketable carrots. (Table 6). Numbers of nematodes significantly increased between the two sample dates.

Table 1. Comparison of TELONE C-17 at 34 L/ha and 57 L/ha for the control of root knot and lesion nematodes and Pythium root die back on Site 1, 1999.

	TELONE C-17 CHECK	TELONE C-17 @ 34 L/ha	TELONE C-17 CHECK	TELONE C-17 @ 57 L/ha
% Marketable	47.78 b *	88.15 a	59.77 b	85.34 a
% Pythium root die back	7.04 b	4.67 a	19.95 b	6.59 a
% Root knot nematode	46.81 b	5.88 a	15.67 b	3.89 a
Pin nematodes in July	27160 b	8335 a	305 b	0 a
Pin nematodes in Sept	77975 a	157200 a	3395 b	675 a
Lesion nematodes in July	0 b	0 a	7755 b	960 a
Lesion nematodes in Sept	0 a	0 a	70450 a	19860 a
Root knot nematodes in July	0 a	0 a	500 a	0 a
Root knot nematodes in Sept	4400 a	500 a	2350 a	0 a

* Pairs of numbers within a row followed by the same letter are not significantly different at $P = 0.05$, Gosset Paired T Test.

Table 2. Comparison of TELONE C-35 at 34 L/ha and 57 L/ha for the control of root knot and lesion nematodes and Pythium root die back on Site 1, 1999.

	TELONE C-35 CHECK	TELONE C-35 @ 34 L/Ha	TELONE C-35 CHECK	TELONE C-35 @ 57 L/Ha
% Marketable	51.70 b *	87.10 a	72.33 b	93.44 a
% Pythium root die back	10.76 b	5.16 a	17.33 b	1.51 a
% Root knot nematode	36.76 b	8.22 a	7.28 b	3.89 a
Pin nematodes in July	36190 b	3985 a	10 b	15 a
Pin nematodes in Sept	85290 a	104950 a	8700 a	1190 a
Lesion nematodes in July	0 b	10 a	7090 b	1255 a
Lesion nematodes in Sept	0 a	50 a	78650 a	17345 a
Root Knot nematodes in July	0 a	10 a	50 a	10 a
Root Knot nematodes in Sept	2650 a	2550 a	400 a	0 a

* Pairs of numbers within a row followed by the same letter are not significantly different at P = 0.05, Gosset Paired T Test.

Table 3. Comparison of TELONE C-17 at 34 L/ha and 57 L/ha for the control of lesion nematodes and Pythium root die back on Site 2, 1999.

	TELONE C-17 CHECK	TELONE C-17 @ 34 L/ha	TELONE C-17 CHECK	TELONE C-17 @ 57 L/ha
% Marketable	57.0 b *	66.5 a	53.8 b	84.4 a
% Pythium root die back	27.4 a	14.7 a	27.6 a	8.2 a
% Lesion nematode	17.6 a	20.9 a	14.7 a	13.0 a
Pin nematodes in July	1440 a	0 a	350 a	5 a
Pin nematodes in Oct	25300 a	3253 a	32925 a	6245 a
Lesion nematodes in July	833 a	1247 a	410 a	700 a
Lesion nematodes in Oct	1267 a	7380 a	2000 a	5925 a

* Pairs of numbers within a row followed by the same letter are not significantly different at P = 0.05, Gosset Paired T Test.

Table 4. Comparison of TELONE C-35 at 34 L/ha and 57 L/ha for the control of lesion nematodes and Pythium root die back on Site 2, 1999.

	TELONE C-35 CHECK	TELONE C-35 @ 34 L/ha	TELONE C-35 CHECK	TELONE C-35 @ 57 L/ha
% Marketable	25.1 b *	52.8 a	49.6 b	73.7 a
% Pythium root die back	59.7 a	33.9 a	31.8 a	22.0 a
% Lesion nematode	14.8 a	12.7 a	18.0 a	3.5 a
Pin nematodes in July	50 a	555 a	80 a	250 a
Pin nematodes in Oct	11375 a	50 a	21680 a	80 a
Lesion nematodes in July	2050 a	860 a	1240 a	328 a
Lesion nematodes in Oct	13050 a	4400 a	5475 a	1740 a

* Pairs of numbers within a row followed by the same letter are not significantly different at $P = 0.05$, Gosset Paired T Test.

Table 5. Evaluation of TELONE C-17 and C-35 at 34 L/ha and 57 L/ha for the control of root knot and lesion nematodes and Pythium root die back on Site 1, 1999

Treatment	Rate L/ha	Pin Nematodes		Root Knot Nematodes		% Market-able	% Pythium
		July	Oct.	July	Oct.		
TELONE C-17	34	8335 a *	157200 c	0 a	500 a	88.1 a	4.7 a
TELONE C-17	57	0 a	675 a	0 a	0 a	85.3 a	6.6 a
TELONE C-35	34	3985 a	104950 c	0.4167	2550 a	87.1 a	5.2 a
TELONE C-35	57	15 a	1190 a	0.4167	0 a	93.4 a	1.5 a
TELONE C-17 Check	34	27160 b	77975 abc	0 a	4400 a	47.8 b	7.0 ab
TELONE C-17 Check	57	305 a	3395 a	50 a	2350 a	59.8 b	19.9 c
TELONE C-35 Check	34	36190 b	85290 bc	0 a	2650 a	51.7 b	10.7 abc
TELONE C-35 Check	57	10 a	8700 ab	50 a	400 a	72.3 ab	17.3 bc

* Numbers in a column followed by the same letter are not significantly different at $P = 0.05$, Fisher's Protected LSD Test.

Table 6. Evaluation of TELONE C-17 and C-35 at 34 L/ha and 57 L/ha for the control of root knot and Lesion nematodes and Pythium root die back on Site 2, 1999.

Treatment	Rate	Pin Nematodes		Lesion Nematodes		% Marketable	% Pythium
		Jul	Oct	Jul	Oct		
TELONE C-17	34 L/ha	0 a	4355 a	1245 a	7764 c	68.3 abc	12.9 ab
TELONE C-17	57 L/ha	5 a	6245 a	700 a	5925 bc	84.4 a	8.2 a
TELONE C-35	34 L/ha	555 a	11375 ab	860 a	4400 ab	52.8 bc	33.9 b
TELONE C-35	57 L/ha	250 a	21680 abc	530 a	1740 a	73.7 ab	22.0 ab
TELONE C-17 Check	34 L/ha	1396 b	26401 bc	832 a	1651 a	58.9 bc	25.6 ab
TELONE C-17 Check	57 L/ha	350 a	32925 c	410 a	2000 a	56.8 bc	27.6 ab
TELONE C-35 Check	34 L/ha	50 a	4875 a	2050 a	13050 d	25.1 d	59.7 c
TELONE C-35 Check	57 L/ha	80 a	12675 ab	1240 a	5475 bc	49.6 c	31.8 b

* Numbers in a column followed by the same letter are not significantly different at P = 0.05, Fisher's Protected LSD Test.

END OF SECTION P (Report # 128, Pages 351-355).

SECTION Q: RESIDUES RÉSIDUS

REPORT /RAPPORT # 129 **See related reports # 46 and 49 (p 120, 126) which report on imidacloprid and permethrin residues, respectively in 99INSECTS-PMRR.**

PAGES: 356 - 358

EDITOR **Dr. Brian D. Ripley**

Lab Services Div.
University of Guelph
95 Stone Road West, Loading Zone 2
Guelph, Ontario N1H 8J7

Email: lsd.lsd_po(BRipley)
Tel: (519) 767-6206
Fax: (519) 767-6240

1999 PMR REPORT # 129 **SECTION Q: CHEMICAL RESIDUES**
STUDY DATA BASE: 387-2112-9701

NAME AND AGENCY:
HILL B D, INABA D J and BYERS S D
Agriculture and Agri-Food Canada, Research Centre
PO Box 3000, Lethbridge, AB T1J 4B1
Tel.: (403) 327-4561Fax: (403) 382-3156 Email: hillb@em.agr.ca

TITLE: DETECTION OF PHENOXY HERBICIDES IN ALBERTA RAINFALL

MATERIALS: 2,4-D, bromoxynil, dicamba, diclofop, fenoxaprop, MCPA, quinclorac, triallate, trifluralin

METHODS: A 25-cm i.d. stainless steel funnel, setup 60 cm above ground over a 4 liter amber bottle, was used to sample the rainfall at the following five Lethbridge-area locations (duplicate funnels at each location): Lethbridge city (1 funnel at each of 2 residences), 2 Lethbridge Research Centre (LRC) locations, Coaldale (rural/county golf course), and a farm location near Tempest, AB. Rainfall samples were collected at approximately weekly intervals from May 30 to Aug 17. Some samples were intentionally collected during dry periods by rinsing the funnels to check for dry deposition. Samples were extracted by liquid-liquid partitioning into dichloromethane, methylated using diazomethane and analyzed for the following 9 herbicides using MSD-GC with ion-ratio confirmation: 2,4-D, bromoxynil, dicamba, MCPA, diclofop, fenoxaprop, triallate, trifluralin and quinclorac.

RESULTS: Results are summarized in Table 1 with herbicide detections expressed on both a µg/m^2 and a ppb (µg/L) basis. The ppb values depend on the amount of rainfall, but relate to the Canadian Water Quality guidelines and to other reports. With few exceptions, herbicides were detected in the rainfall at every sample date, at every location. 2,4-D was detected most frequently (in all but one sample) and in the highest amounts (max. 1.6-5.1 ppb), with bromoxynil and dicamba usually also present. On June 12, 2,4-D was detected at the Coaldale location and at the Tempest-area farm at 5.1 and 3.6 ppb, respectively, compared with the Canadian Aquatic Life guideline of 4 ppb. Some high herbicide levels (2.0 and 4.2 ppb) also occurred at the two LRC locations in early July; these high levels corresponded to known, nearby spray events. In general, levels at the city location (max. 1.0-1.6 ppb) were lower than at the rural locations. MCPA was detected once, while the other herbicides were not detected in any rainfall samples in 1998. The dry sample collections yielded small amounts of 2,4-D (1-9 $\mu g/m^2$), and traces (<1 $\mu g/m^2$) of bromoxynil and dicamba. The herbicides are entering the air via: 1. application drift, 2. post-spray volatilization from treated plant and soil surfaces, 3. erosion of treated soils.

CONCLUSION: The herbicide amounts detected in Lethbridge-area rainfall in 1998 seem unusually high, especially 2,4-D amounts, which were 10-50x higher than the herbicides previously reported in rainfall at other Canadian (Manitoba, Ontario) locations. These herbicide detections raise several concerns regarding sub-lethal effects on sensitive plant species, negative impacts on surface water quality, and chronic effects on public health.

Table 1. Phenoxy herbicides detected in southern Alberta rainfall in 1998.

Location (No. Sample collections)	Herbicide		No. Detns *	Average	Std. Error	Min.	Max.
Lethbridge (12)	2,4-D	• g/m^2	12	9.98	3.76	2.23	50.3
		ppb	10	0.51	0.16	0.09	1.55
	BROMOX.	• g/m^2	7	3.34	1.85	0.20	14.2
		ppb	6	0.11	0.07	0.02	0.44
	DICAMBA	• g/m^2	5	1.74	0.66	0.65	4.34
		ppb	4	0.1	0.02	0.06	0.16
LRC Rotation U ** (13)	2,4-D	• g/m^2	13	19	5.19	1.01	65.6
		ppb	11	1.15	0.40	0.16	4.24
	BROMOX.	• g/m^2	11	3.11	1.08	0.32	12.1
		ppb	10	0.16	0.05	0.02	0.52
	DICAMBA	• g/m^2	7	2.31	0.7	0.16	5.19
		ppb	7	0.14	0.03	0.02	0.29
LRC North Plots (13)	2,4-D	• g/m^2	13	19.8	5.02	1.82	67.2
		ppb	11	1.21	0.31	0.07	3.18
	BROMOX.	• g/m^2	10	3.47	1.45	0.22	15.6
		ppb	9	0.16	0.08	0.02	0.74
	DICAMBA	• g/m^2	8	14.3	6.08	0.78	48.7
		ppb	7	0.8	0.33	0.02	2.24
Coaldale (13)	2,4-D	• g/m^2	13	12.8	5.54	1.05	77.6
		ppb	10	1.01	0.49	0.07	5.11
	BROMOX.	• g/m^2	8	3.45	1.29	0.16	11.5
		ppb	7	0.2	0.1	0.02	0.75
	DICAMBA	• g/m^2	8	1.87	0.74	0.18	6.55
		ppb	6	0.25	0.1	0.01	0.50
Tempest (13)	2,4-D	• g/m^2	12	10.9	4.76	1.03	61.7
		ppb	9	0.78	0.36	0.14	3.60
	BROMOX.	• g/m^2	8	3.94	1.32	0.22	10.8
		ppb	7	0.21	0.08	0.03	0.63
	DICAMBA	• g/m^2	8	2.65	1.55	0.28	13.3
		ppb	6	0.2	0.12	0.04	0.78

* Some sample collections were dry samples; ppb not applicable.

** MCPA detected once at 3.34 • g/m2 (0.30 ppb).

END OF PLANT PATHOLOGY SECTIONS J - N, PLUS P, Q (Reports # 66-128, Pages 175-358).

END OF 1999 PEST MANAGEMENT RESEARCH REPORT. 358pp.

1999 RAPPORT # 1-Hb **SECTION Hb: LUTTE BIOLOGIQUES**

CULTURE: Pomme
RAVAGEUR: Tétranyque rouge, *Panonichus ulmi* (Koch), tétranyque à deux points *Tetranychus urticae* Koch et punaise de la molène, *Campylomma verbasci* Meyer.
PRODUIT: Punaise de la molène, *Campylomma verbasci* Meyer (Hereroptera: Miridae)

NOM ET ORGANISME:
GAGNON S[1] CHOUINARD G[2] et MORIN Y[1]
[1] Agrilus Inc., 1350 rue Saint-Charles, C.P. 243, Saint-Alexandre, Québec, J2S 7B8
Téléphone : (450) 346 1304 Télécopieur (450) 346 9425 Courriel : gagnon_sandra@yahoo.com
[2] Institut de recherche et de développement en agroenvironnement, 3300, rue Sicotte, C.P. 480, Saint-Hyacinthe, Québec, J2S 7B8
Téléphone: (450) 778 6522 Télécopieur: (450) 778 6539

TITRE: **ACTIVITÉ PHYTOPHAGE ET PRÉDATRICE DE LA PUNAISE DE LA MOLÈNE DANS LES VERGERS DE POMMIERS**

MÉTHODES: Les populations de punaises (*C. verbasci*) et de tétranyques (*P. ulmi* et *T. urticae)* ont été dénombrées de façon hebdomadaire (1998) et bihebdomadaire (1999) dans 9 vergers commerciaux du sud-ouest du Québec (31 blocs expérimentaux au total). Le dénombrement des punaises a été fait par examen visuel de 50 bourgeons fruitiers par arbre à la 1ère génération, ainsi que 50 bourgeons fruitiers et de 50 nouvelles pousses par arbre à la 2ème génération. Les tétranyques étaient dénombrés selon la méthode présence/absence ajustée (une présence = une feuille contenant au moins 4 formes mobiles, ou un total de 8 œufs et stades mobiles). Vingt feuilles de bourgeons fruitiers ont été examinées par arbre jusqu'à la fin juin et 30 feuilles par arbre (15 bourgeons fruitiers et 15 de nouvelles pousses) à partir de juillet jusqu'à la fin août. Les dommages sur fruits ont été évalués sur 50 bourgeons fruitiers par arbre à la chute de juin. Les dommages en fonction du rapport prédateur/proie (lorsque les proies étaient présentes) a été analysé par régression multiple. La relation entre les populations moyennes de tétranyques et la densité des punaises de la molène a été analysée par régression linéaire et quadratique.

RÉSULTATS: Voir la figure ci-dessous.

CONCLUSIONS: Les dommages causés par la punaise de la molène en 1998 ont été reliés aux densités moyennes de tétranyques et de punaises au pic de la première génération, pour le cultivar McIntosh (R^2=0,62; $F_{2,11}$=9,03; P=0.0048) (fig.1). L'équation résultant de cette relation (dommages = 1,785 +18,402*densité de punaises- 3,345*densité de tétranyques) pourrait permettre la prédiction des dommages dans la gestion des populations de punaises de la molène sur le cultivar McIntosh. En 1999 une relation linéaire expliquait la relation entre les dommages et la population de punaises au pic de la 1ière génération, en absence de tétranyques et pour le cultivar McIntosh (R^2=0,86; $F_{1,5}$=30.01; P=0,0028). La densité des punaises s'avère un facteur déterminant dans l'apparition des dommages qu'elles causent sur les pommes. Le potentiel de prédation de la punaise contre les tétranyques n'a pu être démontré en fin de saison, mais à été démontré en début de saison en 1998 (R^2=0,46; $F_{2,11}$=4,75; P=0,0326). Même si les résultats de 1999 n'ont pu le démontrer statistiquement, la punaise a effectué un bon contrôle là où les tétranyques étaient présentes, a punaise de la molène peut être donc considérée comme un prédateur utile de tétranyques, mais pour effectuer un bon contrôle biologique, son action mériterait d'être combinée à d'autres moyens de lutte. Les résultats et observations des deux dernières années indiquent que la punaise de la molène a un effet plus positif que négatif dans les vergers du sud-ouest du Québec. D'une part elle contribue à la gestion des tétranyques et d'autre part ses dommages à la récolte sont généralement légers et peu importants sur les principaux cultivars présents au Québec. En effet, les dommages sont produits tôt et, deviennent de moins en moins importants proportionnellement à la pomme au cours de la saison, jusqu'à disparaître presque complètement à la récolte. L'observation de dommages dus à la punaise de la molène en 1998 et 1999 sur le cultivar McIntosh confirme l'hypothèse selon laquelle les dommages seraient reliés à la phénologie des pommiers au moment de l'éclosion des nymphes. En effet, les dommages se produisant surtout avant le stade calice, ceux-ci ne seraient observés que lorsque les nymphes émergent avant que les pommiers aient atteint le stade phénologique de la nouaison (ce qui fut le cas pendant les deux années de l'étude). Les pommes seraient à partir de ce moment très peu sensibles aux dommages de la punaise de la molène.

Figure 1. Pourcentage de dommages sur fruits (cultivar McIntosh) en fonction de la densité des punaises et des tétranyques telle que notée en 1998 dans des vergers du sud-ouest du Québec.